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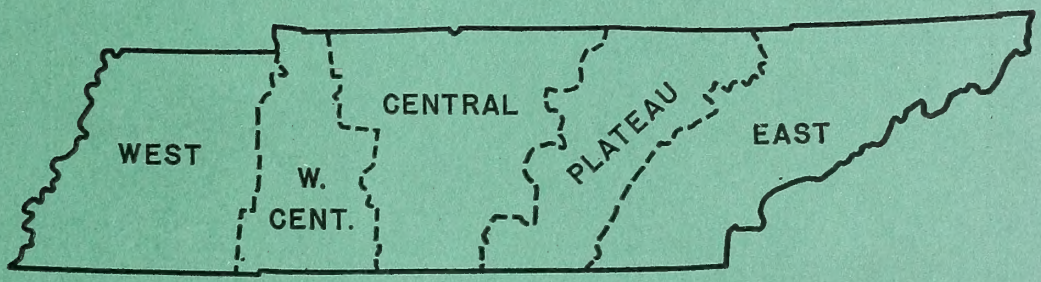
TENNESSEE'S TIMBER ECONOMY



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U. S. DEPARTMENT OF AGRICULTURE

Forest Service
United States Department of Agriculture
Forest Resource Report No. 9

SOUTHERN FOREST EXPERIMENT STATION

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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST RESOURCE REPORT NO. 9 WASHINGTON, D. C., 1955

Tennessee's Timber Economy

HERBERT S. STERNITZKE, *forest economist*

SOUTHERN FOREST EXPERIMENT STATION

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON, D. C., 1955

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. . . . . PRICE 55 CENTS

Preface

THIS REPORT on Tennessee's forests presents the principal findings of that part of the nationwide Forest Survey which was conducted in Tennessee in 1948–50. This was the first statistically designed and comprehensive survey made for the forest resources of Tennessee. It included an inventory of forest lands and standing timber, rates of timber growth and mortality, and industrial utilization of timber for lumber and various other forest products.

The resource facts contained herein provide reliable data on a statewide basis and are basic to both public and private long-range plans for timber production and for guidance of forest industry development. The report spotlights the major timber resource problems in Tennessee and offers some solutions to them. While this study deals with the timber resource, the values of forests for watershed protection, wildlife, soil erosion control, recreation, and grazing are also recognized.

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Tennessee Timber Highlights

TIMBER PRODUCTS ARE A MAJOR SOURCE OF INCOME IN TENNESSEE. In 1950, the value of timber products represented about 6 percent of the total income payments in Tennessee. The contribution of Tennessee's forests to the recreation industry and to other values—water, soil, wildlife—although not easily expressed in monetary terms, also looms very large.

PRIMARY WOOD-USING INDUSTRIES COMPRISE NEARLY 3,000 PLANTS. Most numerous are sawmills, which number some 2,700. In addition, there are 5 pulp mills, 14 veneer mills, 38 cooperage plants, and 139 miscellaneous plants (principally handle stock mills). Most of the wood used by these plants is cut from nearby forests, but much of the pulpwood travels up to 200 miles from woods to mill, and about half is shipped out of the State, chiefly to mills in Mississippi, the Carolinas, and Virginia.

FORESTS COVER ALMOST HALF OF THE STATE'S LAND AREA. The most heavily timbered part is the Cumberland Plateau and eastern Highland Rim section. West Tennessee is the least forested.

MORE THAN NINE-TENTHS OF THE COMMERCIAL FOREST LAND IS PRIVATELY OWNED. The remainder is almost entirely in State and Federal ownership.

TENNESSEE'S TIMBER SUPPLY TOTALS 5.7 BILLION CUBIC FEET. This volume includes 16.2 billion board-feet of sawtimber. The trees are chiefly hardwoods, mainly the oaks, hickories, gums, and yellow-poplar that once made Tennessee the Nation's foremost producer of hardwood lumber. Softwoods, found largely in the Cumberland Plateau and eastern Tennessee, are mostly southern pines, but also include redcedar, cypress, white pine, and hemlock.

NEARLY THREE-FIFTHS OF ALL THE FOREST IS WELL STOCKED. That is, it has enough trees of all kinds, sizes, and qualities to utilize the growing capacity of the soil. Many of the trees, however, are still too small or too poor in quality to be of much commercial use, and the volume and quality in sawtimber trees is much less than it could be under good forest management. The equivalent growing space of about one acre in six is wasted because it is occupied by cull hardwoods—trees too rotten or limby to be considered merchantable. The best stocking of good trees and the fewest cull trees are found in the forests of the Unaka and Smoky Mountains and the Great Valley.

TIMBER GROWTH IN CUBIC FEET EXCEEDS CUT. The net growth of all merchantable trees in 1949 totaled 286 million cubic feet. Logging removed less than this—about 252 million cubic feet. Growth on all merchantable timber thus exceeded the total cut by 13 percent.

BUT SAWTIMBER-SIZE TREES ARE BEING OVERCUT. The harvest of sawtimber-size trees in 1949 totaled 1,013 million board-feet, whereas growth on trees of this size was only 877 million board-feet. Softwoods are being more seriously overcut than hardwoods.

TO IMPROVE FOREST CONDITIONS CALLS FOR THE FOLLOWING CONSTRUCTIVE MEASURES:

1. PROTECTION.—Improve fire fighting facilities in areas presently protected and extend protection to counties that still lack it; initiate protective measures against insects, disease, and grazing damage.

2. CULL HARDWOOD REMOVAL.—Return more than 2 million acres of growing space to the production of useful wood products by utilizing, girdling, or otherwise eliminating cull hardwoods.

3. FOREST PLANTING.—In the next 20 years, plant about 940 thousand acres of poorly stocked and denuded forest land.

4. BETTER UTILIZATION.—Use each tree cut for the most valuable products it will yield; extend practice of multiple-product harvesting and marketing. Improve operating efficiency of the several thousand circular sawmills.

5. IMPROVED HARVESTING PRACTICES.—Harvest timber conservatively so as to build up the volume and quality of the timber stands.

Tennessee: Physical and Economic Characteristics[1]

FORESTS, which occupy 47 percent of all the land in Tennessee, are one of the State's most important natural resources. The benefits from these forests—timber, water, recreation, and wildlife—form the economic pillar of many communities and are important to the welfare of the entire State.

Forest Survey Regions

Tennessee is a state with widely contrasting physiographic features. A relief map shows a succession of mountain slopes. From the peaks of the Great Smoky Mountains—6,642 feet in elevation on Clingman's Dome—the land drops toward the west in a series of plateaus and ridges to the Mississippi bottom lands.

The Forest Survey regions in Tennessee—west, west-central, central, Plateau, and east (fig. 1)—conform partly to major physiographic areas[2] though they are distinguished also on the basis of forest types and economic conditions. Boundaries follow county lines for convenience in compiling data.

The Survey region termed east Tennessee is made up of two physiographic areas—the Unaka and Smoky Mountains and the Great Valley. The mountains, which extend along the North Carolina line in a strip 2 to 20 miles wide, are rough and rugged. Settlement antedates the Revolutionary War, but agriculture could not get much of a hold except in the coves and valleys (fig. 2). Most of the mountains remain a forested wilderness now in public ownership. The Great Valley, which flanks the Smokies, is 30 to 60 miles wide. Its floor is composed of a succession of minor ridges and valleys running northeast to southwest. Viewed from

[1] Historical material in this section is drawn largely from the following sources: (1) FEDERAL WRITERS' PROJECT. TENNESSEE, A GUIDE TO THE STATE. 558 pp. New York. 1939. (2) HOUGH, FRANKLIN B. REPORT UPON FORESTRY. 650 pp. Washington, D. C., 1878. (3) SARGENT, CHARLES S. REPORT ON THE FORESTS OF NORTH AMERICA. U. S. Census Office, Dept. of the Interior. 1884. (4) Various other U. S. Census reports.

[2] Major physiographic regions in Tennessee are delineated on map following p. 56.

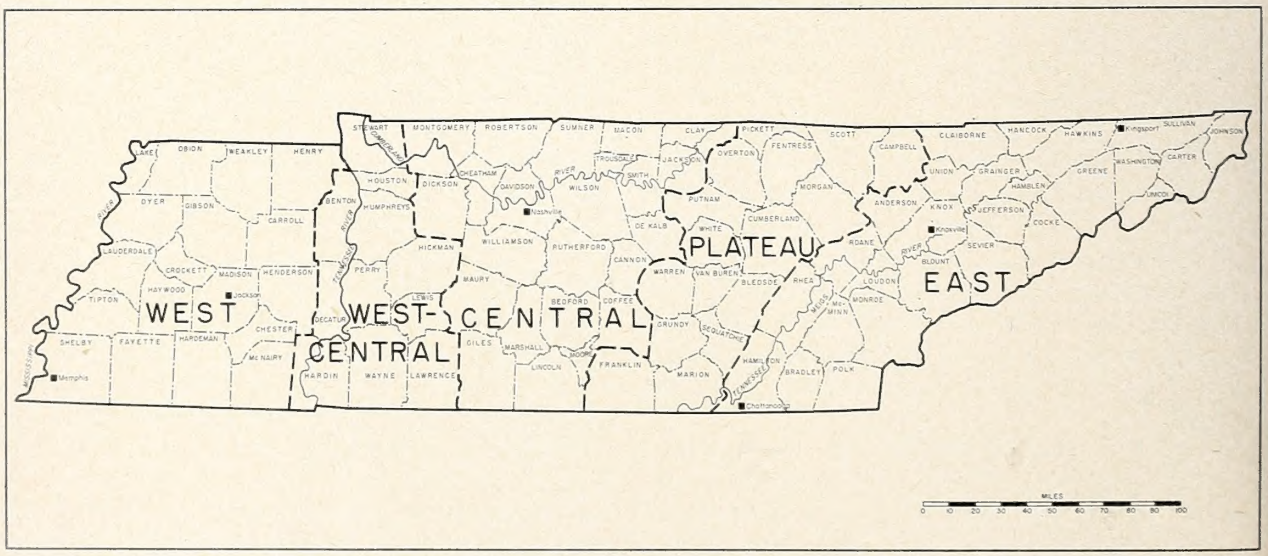

FIGURE 1.—*Forest Survey regions in Tennessee.*

FIGURE 2.—*Broad expanses of forest typify the mountain landscape of east Tennessee.* (*Tenn. Conservation Dept. photo.*)

FIGURE 3.—*Farms are generally small in the predominantly forested Cumberland Plateau.* (*Tenn. Conservation Dept. photo.*)

the mountains to the east or west, the floor appears as a common plain, although some of its ridges rise to 800 feet. The steep slopes are mainly forested, but spotted with thousands of tiny "patch farms." The valleys have some deep soils and many prosperous farms.

This region is the most heavily industrialized, a reflection of the availability of a large variety of minerals and of low-cost electric power and fuel. Of the $957 million of value added by manufacture in the State in 1947, about 40 percent was produced in east Tennessee alone. Chattanooga, Knoxville, and Kingsport are the principal manufacturing centers.

The Plateau region includes the Cumberland Plateau and most of the eastern Highland Rim. The Cumberland Plateau rises a thousand feet above the Great Valley. Erosion has cut irregularly into its sandstone rocks, especially in the northeast. The soils are mainly thin, porous, and unproductive for agriculture. Farms are generally small, with about as much pasture as cropland (fig. 3). Most of Tennessee's coal, the State's most valuable mineral product, comes from the Cumberland area. The Highland Rim has a flat to rolling topography for the most part. Some of its soils are suited to crops, but others, especially on the inner part of the Rim, are very poor.

Central Tennessee encompasses virtually the whole Central Basin and part of the Highland Rim that surrounds it. The Basin, more than 6,000 square miles in area, lies about 400 feet below the surrounding Rim. Nashville, the State capital, is the economic and cultural hub of the region; it is also the third largest manufacturing center in the State, ranking next to Memphis and Chattanooga. Soils of the region, which are typically of the brown loam type, are some of the most productive in the State. Livestock and dairying are the main sources of farm income (fig. 4). In 1949, the value of livestock and livestock products alone exceeded 62 million dollars. Tobacco, principally burley, also ranks high.

FIGURE 4.—*Improved pasture, fine cattle, and redcedar woodlands are common features in the Central Basin.* (*TVA photo.*)

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West-central Tennessee is mostly Highland Rim country, but it includes also the western valley of the Tennessee River. The valley averages only 12 miles in width and much of the bottom land has been inundated since the construction of Kentucky Dam. Farms are generally small and receive income from a variety of crops such as dairy products, livestock, cotton, and tobacco. Outside of the stream bottoms the soils are generally poor (fig. 5).

West Tennessee, flanked by the Mississippi and Tennessee Rivers, is a region of fertile alluvial soils and gently rolling uplands (fig. 6). It drops gradually in elevation from 600 feet on its eastern ridges above the Tennessee to 300 feet at the bluffs overlooking the Mississippi. Soils of wind- or stream-laid origin prevail. Windblown (loessial) soils are of great depth in the Mississippi bluffs, but gradually decrease toward the east, until they expose sedimentary sandy loams. The area is largely agricultural. Much of the forest is confined to the wide bottoms of the sluggish streams. These bottoms are generally fertile, but some are so poorly drained and frequently flooded that they are valuable chiefly for timber.

Memphis is the economic focal point of west Tennessee. It is the principal market for the cotton crop, which is the main income source for the predominantly rural population. Memphis also serves as the marketing and manufacturing center for much of the hardwood of west Tennessee and adjoining States. The bottom-land forests contain most of the high-grade timber in the region; upland forests are of secondary importance.

The Original Forests

At the time of earliest settlement, age-old forests blanketed all regions of the State.

Although hardwood species were most numerous, softwoods were by no means absent. The swamps and stream bottoms of west Tennessee supported large bodies of cypress. Shortleaf pine occurred extensively in the Cumberland Plateau and in smaller patches in the Highland Rim. White pine was less abundant, but could be found in many parts of the Cumberland Plateau and the mountain to the east. Redcedar, present in most sections of the State, was

FIGURE 5.—*Eroded soils, small farms, and poor woodlands mark much of the western Highland Rim.* (*TVA photo.*)

most abundant in the Central Basin. Here, it formed forests of considerable area, frequently to the exclusion of all other species. Hemlock, red spruce, and Fraser fir were plentiful in the mountains, the spruce and fir being particularly extensive at elevations above 4,000 feet.

In the main, however, hardwood forests dominated. Oaks, of a dozen or more species, formed the great body of timber from the Mississippi bottoms to the mountains of east Tennessee. White oak, the most valuable tree of this group, grew to enormous size in the Tennessee Valley and west Tennessee, and was also common in other parts of the State. Hickories were abundant on all the poorer soils; tupelo and sweetgum flourished in west Tennessee. Chestnut was one of the most common trees of all, forming perhaps 15 percent of the timber in the Highland Rim and the Cumberland Plateau. The percentage was lower in the Great Valley, but in the mountains chestnut probably comprised as much as one-quarter of the timber (*2*).[3] White ash was plentiful in every part of the State.

[3] Italic numbers in parentheses refer to Literature Cited, p. 39

FIGURE 6.—*Cotton fields and hardwood forests characterize the fertile bottom lands of west Tennessee.* (*Tenn. Conservation Dept. photo.*)

Cherry did not occur in extensive groves, but trees 70 to 80 feet high were scattered through the forests on rich soils. Basswood abounded in the Central Basin and in parts of east Tennessee. Yellow-poplar grew on rich soils almost everywhere and reached great size—6 to 8 feet in diameter and 60 to 75 feet to the lowest limbs (fig. 7). Black walnut was also well distributed over the rich soils of the State. This most valuable tree flourished especially in the Central Basin, the better parts of the Highland Rim, and the valleys of east Tennessee. It reached 6 feet in diameter and more than 100 feet in height.

Other common species included beech, birch, buckeye, cottonwood, elms, black locust, honeylocust, sugar and red maples, red mulberry, sassafras, and sycamore.

Development of the Economy

The long history of farming in the State has had a tremendous influence on the forests. Farming has been the backbone of Tennessee's economic development. Only in recent decades, particularly since the large-scale development of cheap electric power, has manufacturing come into equal, if not greater prominence. Farming still employs more people, but manufacturing produces more income.

Farming

In 1769 farmers from the Carolinas and Virginia began to settle and clear the fertile lands described by the hunters and trappers who had preceded them. From the beginning, corn was a leading money crop, but tobacco and wheat also soon ranked high in the economy of the State.

In eastern Tennessee the farms were small. In the middle of the State, where the topography was more gentle, large farm holdings were common. Here, after a wheat boom that collapsed early, many farmers turned to tobacco and fruit as cash crops, while others began livestock and dairying enterprises.

West Tennessee, with its fertile bottom lands, favored the development of a rich cotton agriculture. In 1818, the Federal Government purchased the region from the Chickasaw Indians and settlers moved in. Forests were cleared, and by 1825 the region had become an important cotton-growing center.

With the pattern of land-use determined—subsistence farms in the east; dairying, livestock, and tobacco farming in the central section; and big-scale cotton production in the west—Tennessee began a long period of agricultural development.

By 1860 there were 82,000 farms with 21 million acres of land, including nearly 7 million acres of improved land. Since then, profound changes initiated with the Civil War have resulted in a great increase in the number of farms, but not in total farm acreage. By 1920 the Census counted 253,000 farms; the figure dropped subsequently to 234,000 in 1945, and 232,000 in 1950. Census statistics show a falling off in total farm land to 18.5 million acres in 1950, although this is probably due to less woodland being enumerated as farm woods rather than to an actual decline in total farm area. Improved farmland increased to more than 11 million acres in 1950.

The most obvious impact of agriculture on Tennessee's forests has been the clearing of land, which has meant a large reduction in forest area, especially on the better soils. Then, the fact that much of the remaining forest has been held as parts of farms has brought with it the special uses of farm woods for many decades: cutting for fuel, posts, and other farm uses; sale of merchantable timber to forest industries; and forage for farm animals. Farmers' use of woodlands has had a great influence on the quality of the timber in Tennessee's forests, and on the species of trees that now predominate.

Another influence, more difficult to trace, has come from the long process of farmland abandonment and reversion to woodland. New acreage is always being cleared from the forest and old land that becomes worn out, eroded, and in other ways submarginal is being abandoned. The process has been slow from year to year, but over the long pull the result has been that a substantial proportion of Tennessee's present forests are on land that was once cropped or at least cleared for pasture.

Abandonment is induced mainly by soil erosion (fig. 8). A survey by the State Planning Commission in 1935 indicated that gullying had virtually ruined about 3 million acres for cultivation, and that sheet erosion had removed at least three-fourths of the surface soil from an additional 11 million acres.

New forests coming in on abandoned fields generally begin with these among the prominent species: sassafras and persimmon in western Tennessee; sassafras, persimmon, hickory, black locust, yellow-poplar, redcedar, winged elm, and hackberry in central Tennessee; pine, yellow-poplar, sassafras, and persimmon in eastern Tennessee. After they are well established the new forests tend to change in compo-

FIGURE 7.—*Yellow-poplar grew to great size in the virgin forest. (Tenn. Conservation Dept. photo.)*

sition, gradually becoming more like the original growth; but pine and yellow-poplar, particularly, have gained through the reversion process. Hall (*4*) pointed out some 40 years ago that pine not uncommonly formed practically pure stands on the old fields of east Tennessee and very often occurred in groups covering 20 to 50 percent of an old field. In the original forests, pine was confined to the poorer sites and rarely occupied more than 10 to 15 percent of the ground. Yellow-poplar, too, frequently came in pure on abandoned lands, or at least comprised a large part of the new stands in contrast to its more scattered occurrence in the original forests.

Industry

Industry grew at a slow pace until the last decade of the 19th century. The number of employees increased from 49,000 in 1899 to 142,000 in 1929. Value added by manufacture rose from $38 million in 1899 to $323 million in 1929. The depression of the early 1930's set industry back here as elsewhere, but since 1935, industry has spurted ahead more rapidly than in most parts of the country. By 1947, the number of employees reached 221,000; value added by manufacture, $958 million.

Much of the impetus to recent industrial growth has come from the abundance of cheap hydroelectric power in the Tennessee River valley (fig.9). The TVA, which began in 1933, operated the largest integrated power-producing system in the United States by 1945. It had a generating capacity in that year of 2½ million kilowatts, a major part of it in Tennessee.

Power development has been made possible by a great surface-water resource. The Cumberland and Tennessee Rivers, with their major tributaries, form water systems that drain most of the State. Their

FIGURE 8.—*Many acres have been ruined for farming by severe soil erosion.* (*Tenn. Conservation Dept photo.*)

upper watersheds are in forested mountain country where precipitation is heavy, and where conditions are ideal for the development of power. It is estimated that Tennessee has from 25,000 to 30,000 miles of rivers and streams which collect nearly half the rainfall (an annual average of about 50 inches over the State) (*8*).

Many resources, in addition to water, lie behind Tennessee's industrial growth. Cotton, tobacco, livestock, and other farm products have provided the raw materials for some of the State's principal industries—textiles and apparel, food products, and leather goods. Minerals are varied and abundant. Although coal is the chief mineral, Tennessee is among the Nation's leading producers of phosphate, sulfuric acid, virgin aluminum, pyrites, iron sinter, copper, zinc ores, and barite (*8*). The large variety and abundance of valuable trees have long sustained the important timber-products industries.

Timber industries developed slowly in the last century. Fuelwood, not lumber, became the first big commercial timber product. Considerable tracts of land were cut over for charcoal until 1869, when coke was first employed in the production of pig iron. Until about 1860, nearly all the hotels, steamboats, railroads, and private dwellings in the cities purchased wood for fuel. As the price of wood advanced and that of coal declined, coal supplanted wood in the cities almost entirely (*7*). Yet, even with this decline, the consumption of fuelwood in the State in 1908 was estimated at 4,730,000 cords (*4*).

Other wood-using industry developed gradually. In the early seventies, northern sawmills sent buyers to look for black walnut. As the walnut became scarcer,

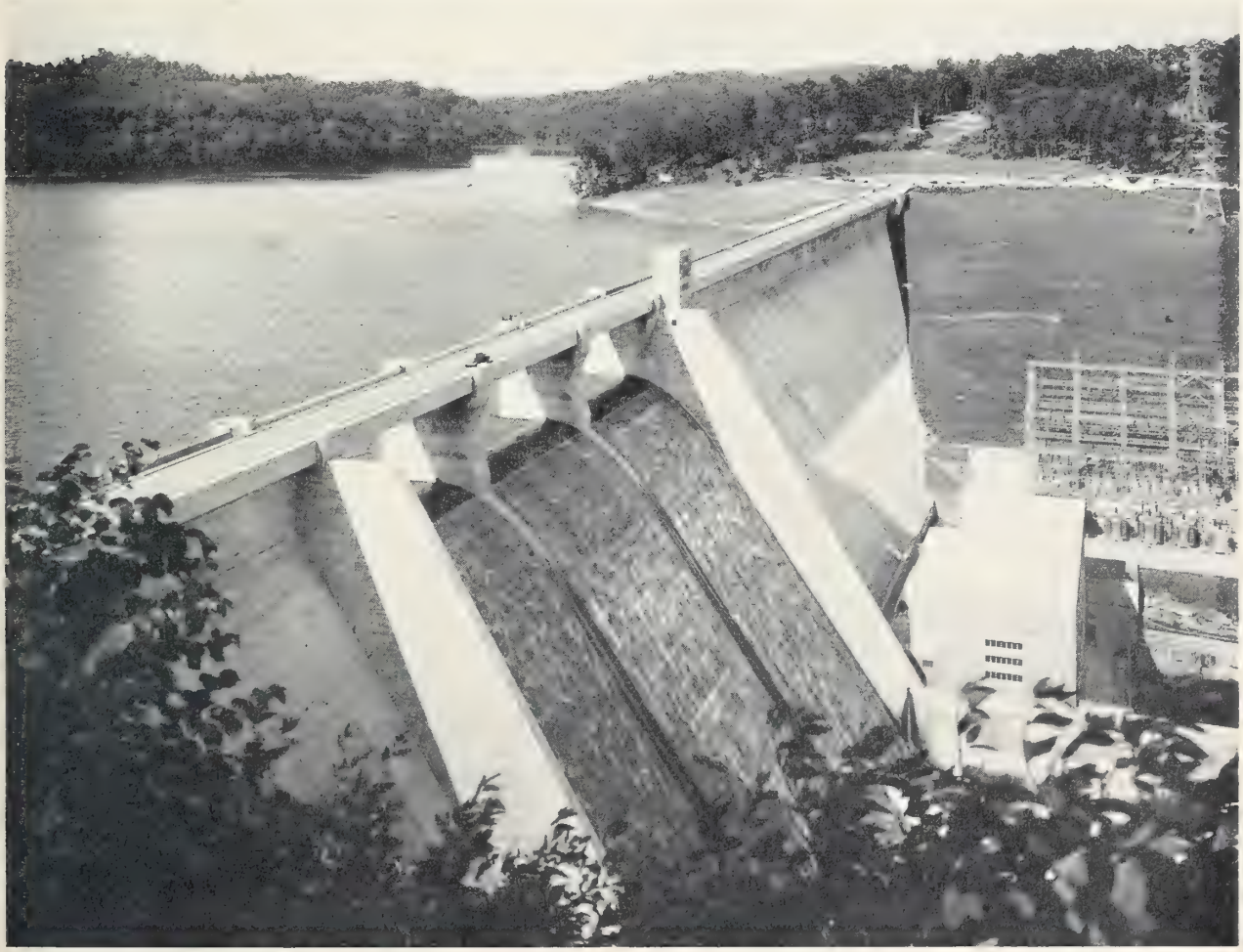

FIGURE 9.—*Norris dam is an important link in the TVA hydroelectric power system.* (*TVA photo.*)

sawmills began to use the high-quality trees of other species—although as late as 1885, few trees other than ash, basswood, black walnut, cherry, cucumber magnolia, white oak, white pine, and yellow-poplar were worth taking.

These "high-grading" operations, which were aimed at relatively few species and only high-quality trees of these species, were enough to create one of Tennessee's primary industries. In the 20-year period from 1880 to 1900, wage earners in the lumber industry (according to the Census) rose from 3,700 to 11,200. Value of lumber products went from less than $4 million to $18 million (nearly 20 percent of the value of all industrial products). A large variety of other timber products came into prominent use—railroad ties, cooperage, vehicle stock, handles, poles, mine timbers, posts, and tanbark.

As choice timber became scarce, the loggers went back again and again for smaller trees and for species they had previously rejected. Timber production reached its peak in the early 1900's and has since fallen off. Nevertheless, a substantial part of the State's economy is still tied to timber.

In 1950 the value of timber cut for domestic use and for sale (logs, bolts, and other round or split products) in Tennessee was $54 million. Further manufacture of timber products within the State added $136 million in value (fig. 10). The total value of $190 million represented about 6 percent of the total income payments in Tennessee in 1950, compared with 10 percent in farming and 15 percent in other manufacturing.

The number of individual workers employed in timber industries cannot be accurately estimated, since much of the employment is part-time. In terms of full employment, however (fifty 40-hour weeks per year), Tennessee's timber industries furnish some 29,500 man-years of work—19,000 in cutting the timber and hauling it to the mills, and 10,500 in manufacture.

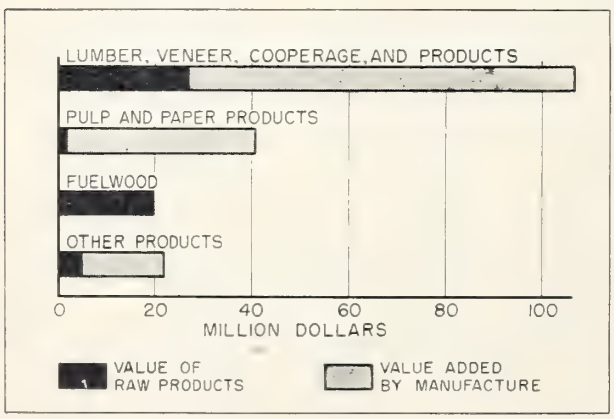

FIGURE 10.—*Value of raw timber products and value added by manufacture, 1950.*

Nontimber Values of the Forest

Though this report is concerned with the forest as a source of timber, the nontimber services of the forest may have an even greater total value. Foremost among the nontimber values are watershed protection, recreation, and wildlife. Sometimes, the forest values are in partial conflict. For example, establishment of the Great Smoky Mountains National Park was based on the premise that timber use would impair the extraordinary recreational value of the area. But in the main, the nontimber uses of the forest can be carried on simultaneously with the commercial production of timber.

Watershed protection may rate well above the timber values in Tennessee. Water is one of the State's primary resources. Industrial water requirements are larger than domestic needs. While much of the water used by industry is for cooling purposes, sizable quantities are needed in manufacturing processes that require water of high quality. Availability of good water from forested watersheds has been a predominant factor in the location of rayon and other chemical-process plants in Tennessee. The electric power generated by the TVA systems—about 5½ million kilowatts early in 1954—comes largely from water. River navigation is assuming increasing importance. The volume of traffic on the Tennessee River in 1953 was one billion ton-miles, 25 times as great as in 1933.[4]

To regulate water for navigation, hydroelectric power, and flood control, huge engineering works have been built along the waterways and more are contemplated. Without the existing engineering structures, the January 1946 flood of the Tennessee River would have caused an estimated flood damage at Chattanooga of $12 million; actual damage was $200,000 (*6*). But important as these engineering works are, their effectiveness is greatly influenced by the condition of the forests which occupy much of the headwaters areas (fig. 11). By facilitating the infiltration of water into the soil and by retarding the runoff of surface water, forests help reduce flood crests and stabilize streamflow. By checking soil erosion, forests also greatly reduce the rate of silta-

[4] Data furnished by TVA.

tion behind dams and sedimentation in navigable streams.

The recreation industry, founded largely on the scenic attractions of forests and waters, is a big business in Tennessee. Recreation values are difficult to measure, but a few statistics indicate the size of the industry. Fifteen State parks draw more than 700,000 visitors a year. A million visitors were attracted by the Cherokee National Forest in 1949, and an even larger total (1½ million) by the Great Smoky Mountains National Park. More than $38 million has been invested in recreational facilities on TVA lakes and shores alone. In all, tourists in Tennessee numbered about 9 million in 1948 and spent an estimated $160 million in the State (*5*).

Not only scenic attractions, but the abundance of wildlife depends heavily on the maintenance of the forest areas. Some 250,000 sportsmen buy licenses annually for hunting and fishing. In pursuing their sport, they spend some $30 million a year and annually take 5 million pounds of game and 10 million pounds of fish (*3*). Furs and skins shipped from the State are worth a few million dollars annually (*1*).

The forest is also a source of forage for farm animals. Improved livestock management, as well as good forest management, would reduce considerably the dependence of farmers upon woodland forage, but under current grazing practices, Tennessee's forest land provides a significant portion of the total food consumed by livestock in the State.

FIGURE 11.—*Much of the headwaters area of the Tennessee River and its tributaries is heavily forested. (TVA photo.)*

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The Timber Resource

Forest Land

AFTER MORE than 150 years of settlement and development, Tennessee is still almost half forested. Some 12.6 million acres out of a total 26.9 million are forest land.[5] Virtually all the forest is capable of producing merchantable timber. About 2 percent, chiefly within the Great Smoky Mountains National Park in east Tennessee, is reserved from timber cutting. Of the commercial forest acreage,[6] 91 percent is privately owned. The largest part of the public commercial timberland is in national forest. Next come State forests and then TVA lands.

The proportion of land in forest varies considerably from one region of the State to the other (fig. 12). The Plateau region, where seven acres out of every ten are in forest, is the most heavily timbered. West Tennessee, with its deep, fertile soils, is largely agricultural; here only 30 percent of the region is in forest. In other sections of the State, the proportion of land in forest ranges between these two extremes. Forest land area, 1948–50, was as follows:

Survey region:	*Thousand acres*	*Percent of total land area*
West	1,794.2	30
West-Central	2,111.4	62
Central	2,345.1	37
Plateau	3,056.7	69
East	3,300.2	49
State	12,607.6	47

Total forest acreage in Tennessee is not likely to decrease from its present 12.6 million. It may increase somewhat as the expansion of industry continues. Poorer croplands will doubtless revert to forest when subsistence farmers turn to employment in the expanding industrial centers.

Forest Types

From the Mississippi bottoms in the west to the mountains in the east, hardwoods are the principal forest trees. More than a dozen species of red and white oaks in mixture with other hardwoods are dominant on three-fourths of the forest area. The generalized distribution of the major forest types is shown on the map following page 56; within these outlines many small areas of other types are intermingled.

[5] Detailed statistics on 1948–50 acreage—as well as on timber volume, growth, and cut—are in the appendix.

[6] The technical and uncommon terms used in this report, as well as certain common terms given special meaning, are defined on pages 41, 43.

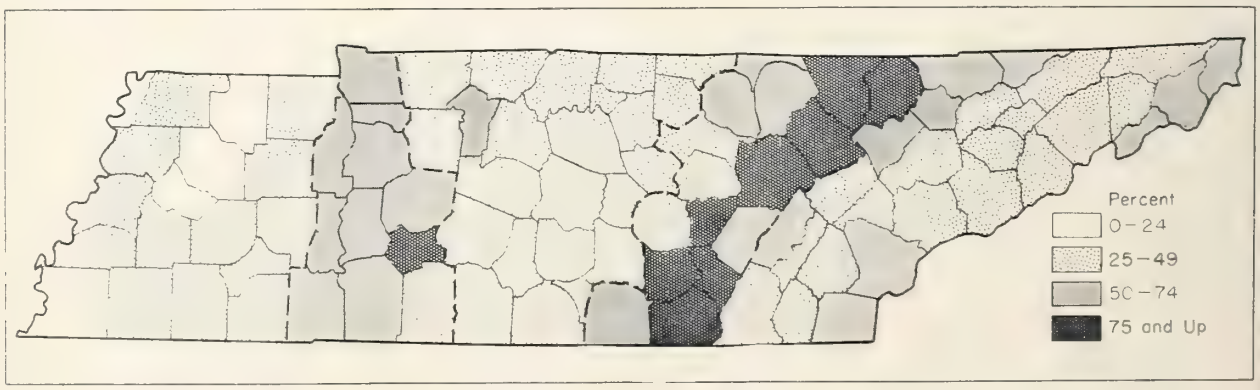

FIGURE 12.—*Proportion of commercial forest land by county, 1948–50.*

Upland hardwoods, occurring rather generally on well-drained sites, form the prevailing forest cover in all survey regions. They occupy some 8.4 million acres and comprise 68 percent of the total commercial forest area (fig. 13). Various oaks—chiefly black, scarlet, southern red, and white—hickory, and yellow-poplar together make up three-fourths of the net cubic volume of the type. Other common associates include sweetgum, blackgum, maple, elm, ash, and beech. Small quantities of pine are also interspersed on one-quarter of the type acreage classified as upland hardwood-pine.

FIGURE 13.—*Upland hardwoods occupy two-thirds of Tennessee's commercial forest land.* (*Tenn. Conservation Dept. photo.*)

The 922,000 acres of bottom-land hardwood include 7 percent of the commercial forest. Eight-tenths of this acreage is in west Tennessee, on the fertile alluvial lands of the Mississippi Delta and in broad belts along the tributary waterways, particularly the Hatchie, Wolf, Obion, and Forked Deer. In the Tennessee Valley, construction of a network of reservoirs has considerably reduced the type acreage. The principal species include sweetgum, black and tupelo gums, water oaks, cypress, elm, ash, and willow.

The southern yellow pine type is confined almost entirely to the Plateau and east regions. It occupies over 2 million acres, 17 percent of the commercial forest area. Of the net cubic volume in the type, 35 percent is shortleaf pine, 22 percent Virginia pine, 8 percent other softwoods, and 35 percent hardwoods. Shortleaf pine occurs most frequently in association with various upland oaks and hickory. On old fields or burned-over areas, Virginia pine reproduces aggressively and generally forms pure stands.

Seven percent of the commercial forest, 894,000 acres, is in the cedar type. Although this type occurs in all regions, its greatest concentration is in the basin lands of central Tennessee where it occupies 28 percent of the forest area. Here it frequently forms pure stands. In mixed stands, hickory, elm, hackberry, and red oaks are common associates.

Other softwood types—white pine and hemlock—are confined to the higher elevations of east Tennessee and the northern part of the Plateau region. These types cover only 108 thousand acres, 1 percent of the commercial forest area. White pine and hemlock make up three-fifths of the volume in this type. Hickory, yellow-poplar, and black, scarlet, and white oaks are the prevalent hardwood associates.

Growing Stock

The total volume of growing stock is 5.7 billion cubic feet or 464 cubic feet (about 7 cords) per acre of commercial forest. This includes the net volume of both sawtimber and poletimber trees from stump to a 4.0-inch minimum top diameter of the main stem, inside the bark. Poletimber includes sound, well-formed trees from 5.0 to 9.0 inches d. b. h. in softwoods; 5.0 to 11.0 in hardwoods. Sawtimber trees are larger than these sizes.

The concentration of growing stock is heaviest in east and west Tennessee, where the commercial forest averages about 8 cords per acre. In the interior regions volume per acre averages 6 cords. Hardwood volume considerably exceeds softwood in all sections, though softwoods, chiefly southern pines, reach an appreciable volume in the east and Plateau regions (fig. 14).

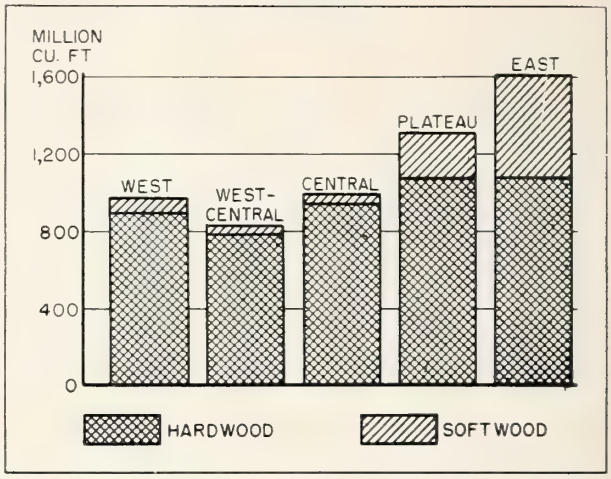

FIGURE 14.—*Growing stock by Survey region, 1948–50.*

Sawtimber trees account for 3.4 billion cubic feet of the growing stock; poletimber trees for 2.3 billion cubic feet (fig. 15). This proportionally large volume (40 percent) in poletimber trees emphasizes the young, immature character of the forest. Although requirements for pulpwood and similar small-tree products can be supplied by pole-size trees, much of the poletimber volume should be reserved for future production of the sawlog-size material that constitutes the chief requirement of the State's wood-using industries.

Not included in the estimate of growing stock is an additional 2.3 billion cubic feet of sound wood volume that is largely unmerchantable. Of this, 28 percent is in hardwood limbs, 69 percent is in cull trees—both softwood and hardwood—and 3 percent is in salvable

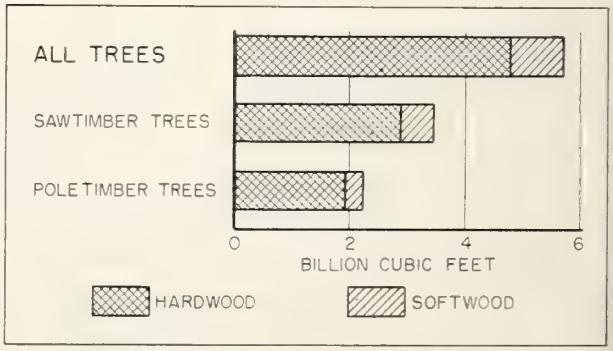

FIGURE 15.—*Growing stock volume in poletimber and sawtimber trees, 1948–50.*

dead trees, mostly chestnut. Current utilization of this material is limited chiefly to fuelwood, though some chestnut is being cut for pulpwood and tannin extract wood. About one-half billion cubic feet of the total is in pine and soft-textured hardwoods considered suitable for pulping. The increasing demand for pulpwood may afford an opportunity to market a much greater portion of this material than at present.

Sawtimber Volume

The net volume of sawtimber in Tennessee totals 16.2 billion board-feet, International ¼-inch rule.[7] This rule, which closely approximates green lumber tally, is used for all board-foot volumes in this report. Included in the board-foot estimate are the sawlog portions of merchantable hardwood trees at least 11.0 inches d. b. h. and softwoods 9.0 inches d. b. h. and larger.

Four-fifths of the sawtimber volume is in hardwoods, one-fifth in softwoods (fig. 16). The oaks are by far the principal species and account for 54 percent of the hardwood sawtimber. Hickories, yellow-poplar, and gums, with over 1 billion board-feet each, furnish an additional 28 percent of the hardwood volume. All other species together comprise 18 percent of the hardwood volume although individually none account for as much as 3 percent of the total (fig. 17). Among the softwoods, southern

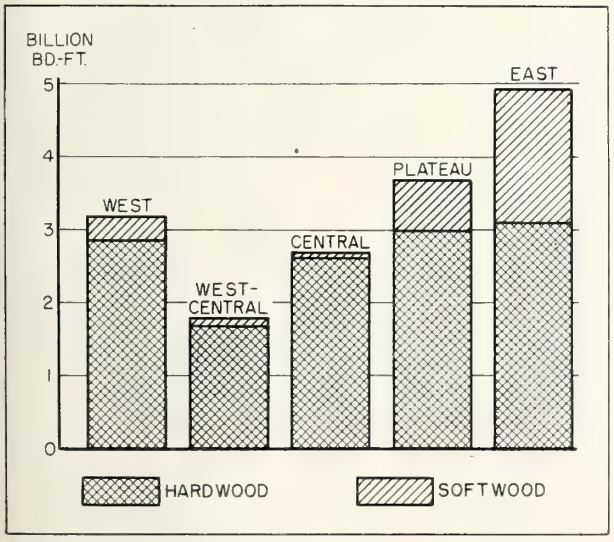

FIGURE 16.—*Sawtimber volume by Survey region, 1948–50.*

[7] Volume by the Doyle rule would total about three-fifths as much for the State.

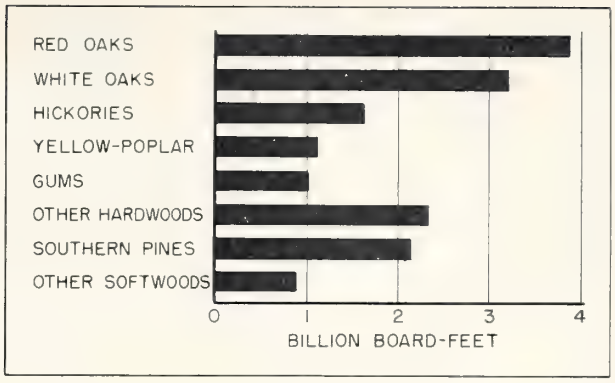

FIGURE 17.—*Sawtimber volume by species, 1948–50.*

pines (with shortleaf predominating) make up 71 percent of the sawtimber volume. Of the less abundant softwoods, cypress is prominent only in the west; redcedar only in the central region; and white pine and hemlock only in the east.

Although sawtimber stands occupy less than one-quarter of the commercial forest, they contain almost two-thirds of the sawtimber volume and they average 3,500 board-feet per acre (fig. 18). The remaining sawtimber volume occurs in stands having less than 1,500 board-feet per acre. This latter volume includes not only residual trees from previous logging operations, but also thrifty, young trees that have recently attained sawtimber size. Under prevailing economic conditions, much of the sawtimber in these young-growth areas cannot be considered available, because the volume per acre is generally too low to support commercial sawlog operations.

The average per-acre volume of sawtimber leaves much to be desired. The total commercial forest area only supports about 1,300 board-feet per acre. In the heavily cutover west-central region, the volume of sawtimber on the average acre is not much more than 800 board-feet. By contrast, the highest regional average—almost 1,800 board-feet per acre—occurs in west Tennessee, where there is a concentration of bottom-land hardwood forests. In these forests the trees grow rapidly and to large size, and commercial cutting, because of higher standards of merchantability, is lighter than in other types of forest. In all regions, however, Tennessee's forests can support considerably heavier volumes of timber.

The low per-acre volumes are mirrored in the small size of sawtimber trees. Past cutting has reduced the average size of hardwood sawtimber to 14 inches d. b. h.; of softwood to 12 inches.

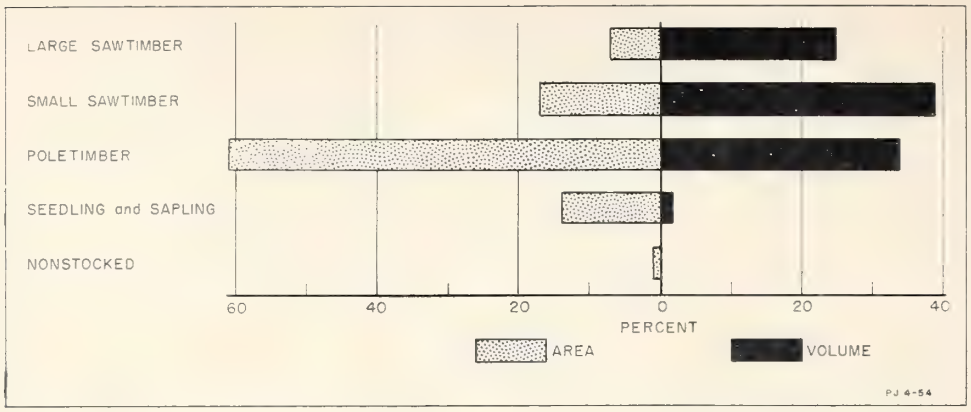

FIGURE 18.—*Commercial forest area and sawtimber volume by stand-size class, 1948–50.*

One-quarter of the hardwood sawtimber volume is in trees 20 inches d. b. h. and larger (table 1). More than half of the hardwood sawtimber is concentrated in trees 14 to 18 inches, while slightly less than one-quarter is in 12-inch trees. Softwood sawtimber is equally distributed between 10- to 12-inch trees and those 14 inches d. b. h. and larger (table 2). Merely a seventh is in trees 20 inches d. b. h. and larger.

TABLE 1.—*Hardwood sawtimber volume in Tennessee, by log grade and tree diameter, 1948–50*

D. b. h. class (inches)	All classes	Standard lumber logs			Tie and timber logs
		Grade 1	Grade 2	Grade 3	
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
12	2,965.0			2,407.6	557.4
14 to 18	6,916.4	73.2	1,465.8	4,409.6	967.8
20 and up	3,343.8	1,098.0	1,154.8	882.7	208.3
Total	13,225.2	1,171.2	2,620.6	7,699.9	1,733.5

TABLE 2.—*Softwood sawtimber volume in Tennessee, by tree grade and tree diameter, 1948–50*

D. b. h. class (inches)	All grades	Grade 1	Grade 2	Grade 3
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
10 to 12	1,511.6	158.1	206.9	1,146.6
14 to 18	1,075.9	182.6	224.0	669.3
20 and up	427.3	103.5	89.9	233.9
Total	3,014.8	444.2	520.8	2,049.8

The utility of the sawtimber resource for industrial purposes depends upon its quality. To determine quality, hardwoods were inventoried by log grade and softwoods by tree grade (fig. 19).

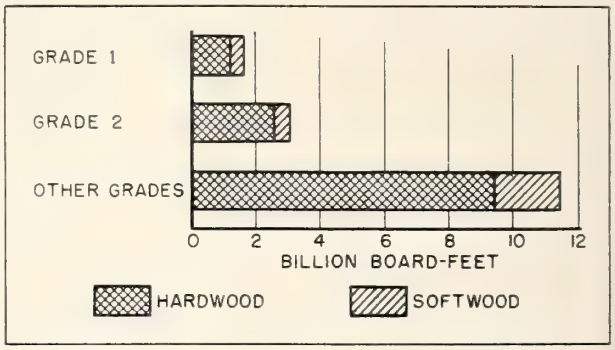

FIGURE 19.—*Sawtimber volume by grade, 1948–50.*

Less than 3.8 billion board-feet, scarcely three-tenths of the hardwood sawtimber, is in good-quality logs—that is, logs which are of grade 1 and 2 and which on the average yield at least 65 and 40 percent respectively of their net volume in No. 1 Common and better grades of lumber. Thus, the great bulk of the hardwood resource, 9.4 billion board-feet, is of a quality below that generally preferred by saw and veneer mills and is of little immediate use to these industries. It is chiefly suitable for low-quality factory lumber, crossties, and structural timber.

Because log grade is closely related to tree size, the biggest proportion of good-quality logs is found in hardwoods 20 inches d. b. h. and larger; about two-thirds of the volume in these trees is in grades 1 and 2. In contrast, only some two-tenths of the volume in 14- to 18-inch trees is in good-quality logs. The 12-inch trees have no grade 1 or 2 logs. As the trees grow in size, however, many of the lower quality logs will improve in grade. It is the great volume now in hardwoods of small diameter, including those of less than sawtimber size, that will provide the high-quality volume of the future if permitted to grow.

Among the softwoods about three-tenths of the sawtimber is in grade 1 and 2 trees having at least 12 feet

of clear bole and 25 percent of their merchantable length clear of limbs and knots in sections not less than 8 feet in length. As with hardwoods, the proportion of better-grade material is greatest in the larger diameter classes. Grade 1 and 2 trees make up 45 percent of the volume in trees 20 inches d. b. h. and larger, 38 percent in 14- to 18-inch trees, and 24 percent in 10- and 12-inch trees.

Sawtimber areas were also classified on the basis of stand quality. Stands classed as fair or better included at least four grade 2 or better hardwood sawlogs or softwood trees per acre. Although this specification is rather lenient, it serves to segregate stands which contain some volume in grades best suited to industrial uses, and which are most likely to be logged first. In hardwood types two-fifths of the sawtimber acreage is in fair or better stands; in softwood types, one-third.

Stand-Size Classes

Most of Tennessee's forest acreage is in stands below sawtimber size (fig. 20). Only 24 percent of the commercial forest is in sawtimber stands—that is, having a net volume of at least 1,500 board-feet per acre. In west Tennessee sawtimber stands occupy at least one-third of the commercial forest. In the east and Plateau regions they make up 25 percent and in the 2 central regions some 17 percent. To insure a maximum yield of merchantable timber from year to year, a far greater proportion of sawtimber area is needed in all regions.

The bottom-land hardwood type, with 41 percent of its area in sawtimber, is the most favorably balanced in stand size. The cedar type is most heavily weighted to small stands, only 3 percent of its area being sawtimber. Sawtimber distributions of the southern yellow pine type and the upland hardwood type approximate the State average, 25 and 23 percent respectively.

Stands in which the trees are mostly below sawlog size occupy 9.4 million acres. The largest part of this acreage, 61 percent of the commercial forest, is in poletimber stands, which predominate in all regions. The remaining acreage, about 15 percent, is chiefly in seedling and sapling stands occupying the newer abandoned fields or areas that have recently been heavily cut or severely burned. The type of management applied to this extensive under-sawlog-size acreage will largely determine the future productivity of the forest. Most poletimber stands are well stocked with commercial species and will soon become sawtimber stands if given adequate protection from fire and premature cutting. Many seedling and sapling areas have sufficient reproduction of seedling or sprout origin to develop eventually into merchantable stands, but protection from fire and grazing is a primary requirement.

Tree Stocking

Fifty-eight percent of the commercial forest in Tennessee is well stocked—that is, has enough sound, well-formed trees of any size or combination of sizes (including established seedlings) to take full advantage of the timber-growing potentialities of the soil (fig. 21). Thirty-three percent is medium stocked, having 40–69 percent of the number of trees required for full stocking. About 8 percent is poorly stocked and only 1 percent is nonstocked (less than 10 percent of full stocking).

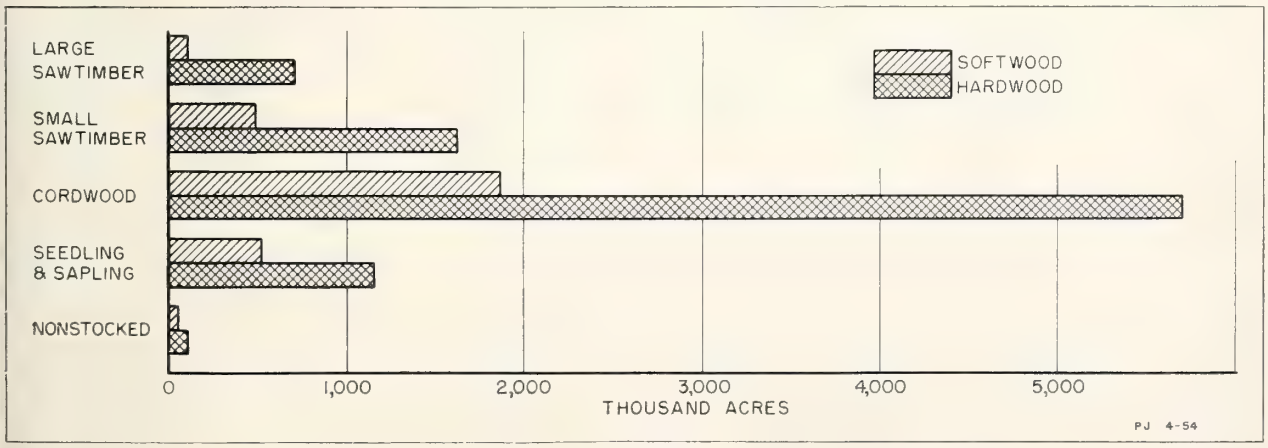

FIGURE 20.—*Commercial forest area by stand-size class and forest type group, 1948–50.*

In relation to stand-size class, sawtimber areas are by far the best stocked. Seventy-seven percent of the sawtimber acreage is well stocked, as contrasted to

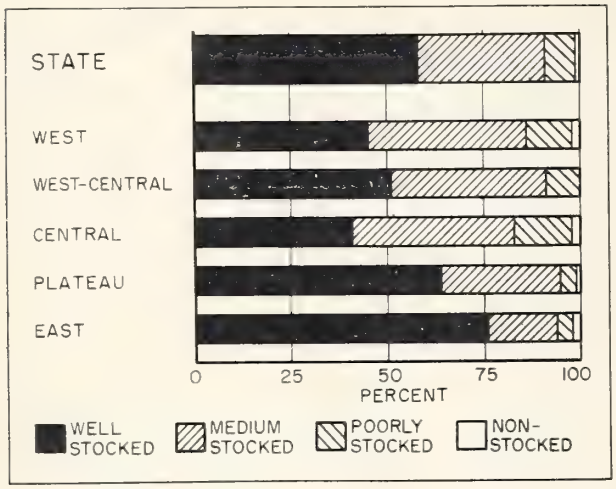

FIGURE 21.—*Tree stocking in commercial forests by Survey region, 1948–50.*

58 percent of the poletimber area and 28 percent of the area in seedlings and saplings. The denser stocking in sawtimber areas does not necessarily indicate a heavy stand of sawtimber trees, but rather implies that total stocking of all tree sizes—both small and large—is good. In stands below sawtimber specifications, the smaller proportion of well-stocked areas strongly reflects the combined result of past heavy cutting, grazing, and fire.

Contributing to the deficiency in stocking in many areas is a considerable accumulation of culls—trees that are unmerchantable now or prospectively because they are rotten, excessively limby, or otherwise of poor form, or are of species that have little commercial use. Three out of ten trees of poletimber size or larger are culls, occupying growing space that might better be used by trees of good form and quality or by new stands of seedlings.

The volume in cull trees is particularly high in hardwood types. In bottom-land hardwoods, four-tenths of the basal area of all live trees 5.0 inches d. b. h. and larger is in cull trees, in upland hardwoods, three-tenths. In softwood types cull, almost all hardwoods, is less than one-fourth of the basal area. Reduction of this large amount of cull—by girdling or poisoning, or, where possible, through utilization—is essential if the State is to make the most of its timber-producing capacity.

The Timber Industries

THE FORESTS of Tennessee provide the raw material for a great number and variety of primary wood-processing plants. Its several thousand sawmills make the State a leading producer of hardwood lumber. Memphis, the wood-working center of the State, is the Nation's largest manufacturer of hardwood flooring. Some 200 nonlumber plants distributed across the State manufacture pulp and paper, cooperage stock, veneer, handle stock, shuttle blocks, and other products. Large quantities of fuelwood, fence posts, and miscellaneous farm timbers are also cut each year.

Production of all timber commodities (logs, bolts, and split pieces) totaled 263 million cubic feet during 1949—60 million in softwood, 203 million in hardwood. Fuelwood and sawlogs were by far the leading items; together they provided 83 percent of the total (table 3). Pulpwood, although of increasing imtance, comprised but 5 percent of the total output. A large number of other products, notably posts, cooperage bolts, and veneer, accounted for the remainder.

TABLE 3.—*Percent of volume of output in Tennessee by round or split timber product, 1949*

Product	All species	Softwood	Hardwood
	Percent	*Percent*	*Percent*
Sawlogs	36	67	28
Fuelwood	47	19	56
Posts	4	4	3
Pulpwood	5	7	4
Cooperage	2	(1)	2
Veneer	1	(1)	1
All other	5	3	6
Total	100	100	100

[1] Negligible.

Virtually all of the State's raw wood goes to plants within the State. Although there is movement back and forth across the State's boundaries, net imports (principally to Memphis plants and to the State's four pulpmills) were but 5 percent of the 1949 timber output.

Lumber

Early lumber production in Tennessee was mostly for local needs. Large-scale expansion of the industry did not begin until the virtual exhaustion of the old-growth hardwoods in the northeastern and central States. The earliest statistics on lumber production in Tennessee, gathered by the Census of 1869, reported only 205 million board-feet for that year. During succeeding decades, however, production mounted rapidly. In 1909, it soared to an all-time peak of 1.2 billion board-feet (fig. 22). In this year Tennessee was the Nation's number one producer of hardwood lumber—principally oak, yellow-poplar, sweetgum, chestnut, and hickory. The subsequent low point was 1932 when, under the impact of the nationwide depression, production declined to 0.1 billion board-feet. Output remained relatively low throughout the nineteen-thirties, but was sharply stimulated by war and postwar demands. In 1946 output totaled 0.9 billion board-feet and in 1953 about 0.6 billion board-feet.

A survey in 1946 by the Forest Service in cooperation with the Bureau of the Census and the Tennessee Valley Authority found 2,789 active sawmills (fig. 23) with a total production of 893 million board-feet. Of this volume, hardwoods made up seven-tenths; softwoods three-tenths.

Small mills, each cutting less than 3 million board-feet a year, produced nine-tenths of Tennessee's lumber output in 1946 (table 4). Because of their mobility and low operational costs, these mills are well adapted to processing the small isolated tracts or the lightly stocked stands of timber that are so prevalent (fig. 24).

Mills cutting less than a half million board-feet annually numbered 2,238, or 80 percent of all active mills. Although the average mill in this class produced only 148 thousand board-feet, the total cut by these mills added up to 37 percent of the State's lumber production. Many of the mills are farm rigs that operate only during slack seasons on the farm. Characteristically, these part-time mills are equipped with the bare essentials for sawing lumber (a circular head-

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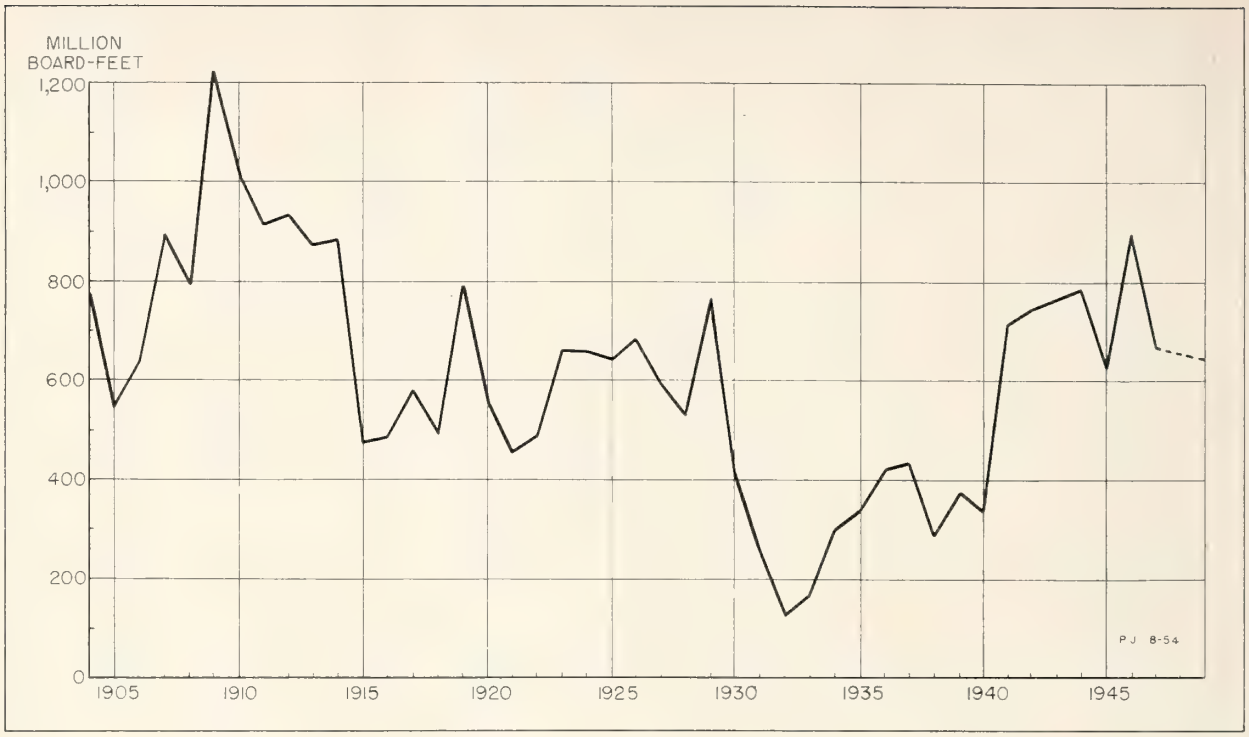

FIGURE 22.—*Lumber production in Tennessee, 1904–49.*

saw, carriage, feed works, and power unit); the lumber is generally edged on the headsaw. Most of them can turn out only a low-quality product, yet they provide cheap local supplies of lumber and furnish employment for rural workers between crop periods.

The 532 mills cutting from one-half to 3 million board-feet annually are the keystone of Tennessee's lumber industry. The group included 19 percent of the active mills and accounted for 52 percent of the total lumber cut. Not only is their production more sustained than that of the smaller mills, but they are generally better equipped and more efficiently operated, and hence produce better lumber. The larger mills in this class are of the permanent type, and logs are commonly hauled to the mill by truck.

Mills cutting more than 3 million board-feet annually numbered 19 and produced 11 percent of the total lumber manufactured in the State (fig. 25). The heaviest concentration of these large mills, chiefly band mills, is in the Memphis area. Unlike the smaller mills—which draw some three-fourths of their wood from within the county in which they are located—these mills reach out to neighboring States for about half of their sawlogs. The west Tennessee mills draw their imports largely from the Delta of Mississippi and Arkansas; while those in the eastern part get their imports principally from Kentucky. The fact that the big mills draw such a large proportion of their logs from outside the State points to a short supply of high-quality timber in Tennessee.

TABLE 4.—*Lumber production of sawmills in Tennessee, 1946*

Size of sawmill [1] (thousand bd.-ft.)	Mills	Lumber production		
		Softwood	Hardwood	Total
	Number	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*
1–499	2,238	108,993	222,287	331,280
500–2,999	532	141,879	320,376	462,255
3,000 and up	19	12,860	86,552	99,412
Total	2,789	263,732	629,215	892,947

[1] As measured by production of lumber in 1946.

Much of the State's lumber output moves in interstate commerce. About one-third of the lumber produced in Tennessee is exported, chiefly to Indiana, Kentucky, and Ohio. Of the total lumber consumed, slightly more than half is produced within the State. Tennessee mills produce some three-fifths of the State's hardwood requirements; two-fifths of its softwood requirements. Alabama and Mississippi provide more than half of the imported lumber, which is about equally distributed between hardwood and softwood.

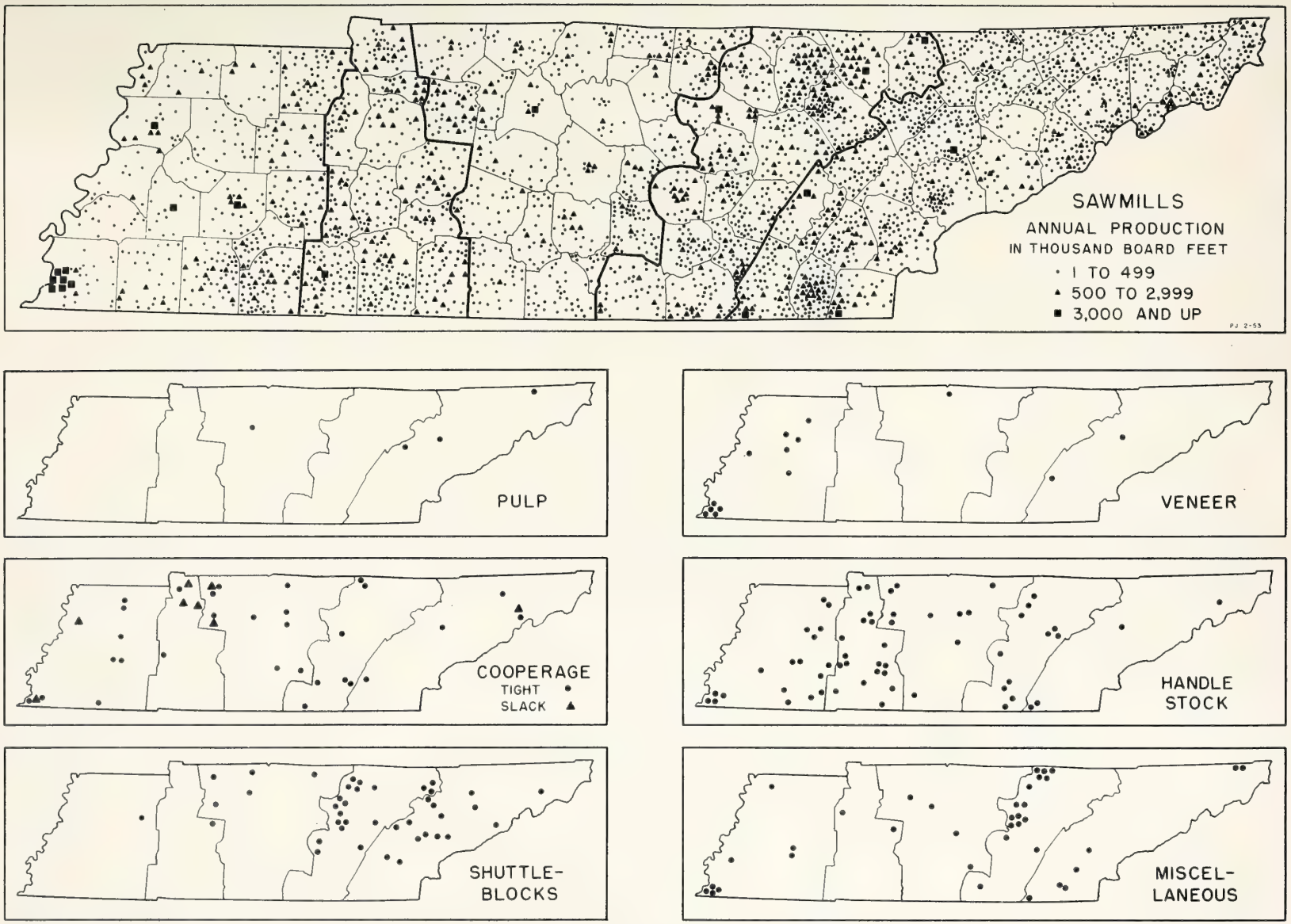

FIGURE 23.—*Location of plants that process raw timber products. (Sawmills 1946; other plants 1949.)*

FIGURE 24.—*There are some 2,700 active small sawmills in Tennessee.* (*Tenn. Conservation Dept. photo.*)

Pulpwood

In 1949 Tennessee's four wood-pulp mills, with a daily plant capacity of 338 tons, consumed 176 thousand cords—all hardwood (fig. 26). Three mills, accounting for six-tenths of the total capacity, produced semichemical pulp for corrugated board; while one soda mill produced book, tablet, and other white papers.

Despite fluctuations with changing paper prices, production of pulpwood in Tennessee, chiefly hardwood, remained relatively stable during the past decade. In contrast, the phenomenal expansion of pulpwood output which has characterized the remainder of the Southern region since 1936 has been based largely on the utilization of pine for sulfate pulp. Hardwood use, although slowly increasing in Tennessee, is still far from its potentiality.

In the 10-year period 1940–49, pulpwood output in the State averaged 153 thousand cords annually; 1949 production totaled 158 thousand cords (fig. 27), of which six-tenths was hardwood. By 1953 production had increased to 234 thousand cords.

The Plateau and east regions are the centers of pulpwood production, and in 1949 virtually all of the pine and seven-tenths of the hardwood was from these two areas. Pulpwood operations, however, extend over most of the State and more than two-thirds of the counties cut some pulpwood.

Of the 158 thousand cords harvested in Tennessee during 1949, about 50 percent (including all of the pine) was exported to mills in Mississippi, the Caro-

FIGURE 25.—*Large sawmills produce only about one-tenth of the lumber manufactured in Tennessee.* F–469307

FIGURE 26.—*Tennessee's pulp mills consume thousands of cords of hardwood annually.* (*Tenn. Conservation Dept. photo.*)

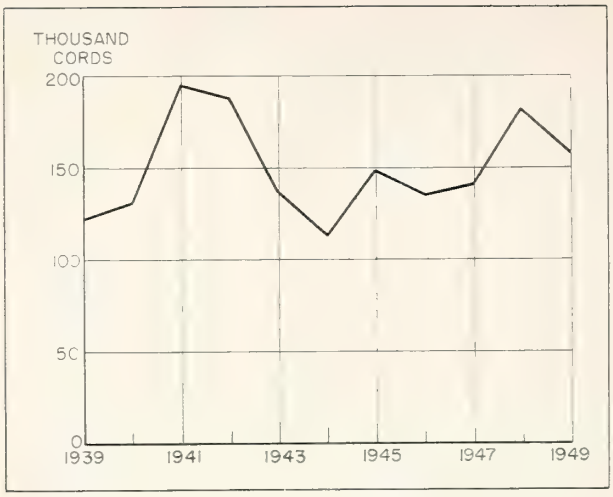

FIGURE 27.—*Pulpwood production in Tennessee, 1939–49.*

linas, and Virginia. Some 96 thousand cords were imported by Tennessee mills, principally from North Carolina, Kentucky, and Georgia. Analysis of pulpwood movement to the four mill units in the State shows that more than half of the pulpwood utilized was produced within an airline radius of 100 miles of the mill to which it was delivered and almost eight-tenths was produced within a 200-mile radius. The maximum haul was about 500 miles. Drawing territories of the individual mills vary considerably according to the timber supply, the availability of the resource in competition with other wood-users, wood-procurement policies, and transportation facilities.

Current expansion of the wood-pulp industry in Tennessee indicates that the pattern of pulpwood production is likely to undergo important changes in the future. A newsprint and sulfate pulp mill at Calhoun came into production in 1954, and this, with some expansion of other plants, has added about 660 tons of daily additional pulping capacity. Although a portion of the pulpwood requirements necessary to supply the added capacity will be drawn from adjoining States, the net effect of the expanded plant capacity of the industry will be a greatly intensified demand for pulpwood (chiefly pine) within the State.

Fence Posts

Like fuelwood, fence posts are chiefly a farm-woodland product cut for local use. In the aggregate, the 14.8 million pieces produced in 1949 accounted for 4 percent of the timber output (fig. 28). The farm-cut posts are mainly cedar among the softwoods; oak and locust among the hardwoods.

FIGURE 28.—*Large quantities of fence posts are harvested annually.* (*Tenn. Conservation Dept. photo.*)

Veneer

The veneer industry was represented by 14 active mills in 1949; 11 in west Tennessee (concentrated largely in the Memphis area), 1 in the central region, and 2 in the east. Some 21 million board-feet of veneer logs were consumed, of which 10.8 million board-feet was drawn from outside the State. Virtually all the veneer was hardwood for containers, paneling, plywood, and furniture.

Tennessee's forests supplied 12.8 million board-feet of veneer logs and bolts during 1949, slightly less than 1 percent of the volume of all timber commodities. The 14 active mills used 82 percent of the production. The rest went to plants in Kentucky and Indiana. Almost seven-tenths of the hardwood was from sweetgum, black and tupelo gums, cottonwood, and yellow-poplar. Softwood, which accounted for less than 2 percent of the total veneer production, was mainly cypress for battery separators.

Cooperage

Production of cooperage bolts totaled 28.2 million board-feet in 1949. More than half of this was from the central and west regions. Tight cooperage bolts, all of which were white oak, made up 83 percent of the total. Elm, hackberry, and oak provided six-tenths of the slack cooperage although various other species, including southern pine, were used.

The 38 active plants consumed 41.6 million board-feet in 1949. About 13.4 million board-feet of this was imported, chiefly from Kentucky and Mississippi. The 30 tight cooperage plants are widely distributed in all regions. Several are owned by distilleries that wish to assure themselves an adequate bourbon barrel stave supply, and most of the others have their entire production contracted for. Slack cooperage plants are concentrated in Dickson, Houston, Stewart, and Montgomery Counties. These plants are largely engaged in turning out hogsheads for the State's tobacco crop.

FIGURE 29.—*Implement handles manufactured in Tennessee are shipped to all parts of the country. (Tenn. Conservation Dept. photo.)*

Fuelwood

Fuel is the largest single use of wood in Tennessee, exceeding even sawlog use. Most fuelwood is cut by farmers for domestic consumption. The total output of 1.7 million cords in 1949 comprised 47 percent of all timber products. However, more than one-third was cut from cull trees, or other non-growing-stock sources, and represents, in general, an effective utilization of this material. Approximately 66 percent of the total was from red and white oaks, 23 percent from other hardwoods, and 11 percent from softwoods.

Though wood is still one of the most common fuels in rural areas, it is estimated that consumption has decreased by more than 50 percent during the past 40 years. Further declines are in prospect as farmers continue to shift to other fuels.

Other Products

All other timber products—chemical wood, excelsior, handle stock, poles, piling, shuttle blocks, and numerous miscellaneous items—provided only 5 percent of the 1949 timber output and are less important to Tennessee's economy than most of those discussed previously. Handle bolts and chemical wood made up almost half of these commodities. Most of the 61 mills manufacturing handle stock are centered in the western part of the State (fig. 29); the 2 plants processing chemical wood by distillation are at Memphis and Wrigley. In addition, there are 41 shuttle block mills, 3 commercial wood-treating plants, and some 32 other primary wood-using plants manufacturing such items as excelsior, wagon spokes, redcedar pencil slats, insulator pins, and ski blanks.

Growth, Cut, and the Timber Supply

THE STABILITY of Tennessee's timber industries depends, among other factors, upon an assured supply of raw material. To bring the problem of timber supply into focus, it is necessary to examine the current growth and annual cut of timber, and to appraise the State's long-range timber needs.

Timber Growth

Current net annual growth of the present timber stands totals 286 million cubic feet for growing stock and 877 million board-feet for sawtimber (table 5). Firm-textured hardwoods—oaks, hickories, and the like—contribute 57 percent of the total growth, soft-textured hardwoods such as gums and yellow-poplar 21 percent, southern pines 17 percent, and other softwoods 5 percent. Species distribution of growth on sawtimber alone is similar to that of total growth.

TABLE 5.—*Net annual growth in Tennessee, by Survey region, 1949*

Survey region	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
West	54.5	4.1	50.4	196.8	16.4	180.4
West-central	40.6	2.9	37.7	114.8	8.5	106.3
Central	48.6	2.2	46.4	135.3	3.5	131.8
Plateau	65.9	14.3	51.6	187.3	47.6	139.7
East	75.9	30.4	45.5	242.8	111.4	131.4
State	285.5	53.9	231.6	877.0	187.4	689.6

These growth estimates represent net volumes that include allowances for the advance of small trees into poletimber and sawtimber sizes, and deductions for mortality due to such causes as suppression, fire, disease, insects, and windthrow. Annual mortality totals 41.1 million cubic feet (0.72 percent) of growing stock; 97.4 million board-feet (0.60 percent) of sawtimber. Much of this heavy annual timber loss can be reduced to a large extent through improved forest management practices.

The importance of small timber in replenishing the available sawlog supply is reflected in the large board-foot growth attributable to recruited volume—that is, the volume of under-sawlog-size trees that annually reach minimum sawtimber specifications. About 57 percent of the net sawtimber growth in Tennessee results from recruited volume. The remainder occurs on trees already of sawtimber size at the beginning of the inventory year.

On a per-acre basis, net annual growth for all stand conditions averages 23 cubic feet (about $\frac{3}{10}$ cord) for all growing stock trees and 71 board-feet for sawtimber trees alone. In sawtimber stands, net growth averages 151 board-feet per acre, ranging from 126 board-feet in the Plateau region to 208 in west Tennessee. The variance in growth per acre encountered among Survey regions is indicative of the considerable difference in site qualities, stand volumes, and other factors. Nevertheless, current growth in all regions falls far below the full potentiality of the forest lands. If stand volumes were built up, sawtimber growth could be increased to about 300 board-feet per acre annually.

Timber Cut

The net volume removed from the growing stock through cutting of timber commodities plus attendant logging residue, was 252 million cubic feet in 1949 (table 6). Four-fifths of the total cut came from trees of sawtimber size.

In proportion to the growing stock, softwoods are more heavily cut than hardwoods. Twenty-five percent of the total cut is from softwoods although they comprise but 16 percent of the growing stock. Oaks furnished 46 percent of the total cut, other firm-textured hardwoods 17 percent, and soft-textured hardwoods the remaining 12 percent.

Nearly 30 percent of the total annual cut is from eastern Tennessee. The west and Plateau regions each supply 20 percent of the total, while the west-central and central regions furnish 12 and 18 percent

TABLE 6.—*Annual cut in Tennessee, by Survey region, 1949*

Survey region	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
West	50.2	3.0	47.2	193.2	13.7	179.5
West-central	30.6	3.0	27.6	124.8	15.2	109.6
Central	45.8	3.5	42.3	169.7	14.6	155.1
Pleateau	51.7	17.4	34.3	221.1	85.4	135.7
East	74.0	35.9	38.1	304.3	165.8	138.5
State	252.3	62.8	189.5	1,013.1	294.7	718.4

respectively. The regional distribution of the cut is thus roughly in proportion to the growing stock available.

Sawlogs represent the largest single item of the annual cut of growing stock—they make up 48 percent. Fuel wood accounts for 34 percent; pulpwood 3 percent; all other products 15 percent (fig. 30).

Timber Volume Trends

Growth on all merchantable timber in Tennessee exceeds the total annual cut on the timber resource—by about 13 percent in 1949, when the latest cutting statistics were compiled. While this superficially suggests a considerable improvement in the resource, it masks the fact that sawtimber—both softwood and hardwood—is being cut faster than it is growing. The harvest of sawtimber trees exceeds growth by about 136 million board-feet or 15 percent. Because of the heavy market demand for southern pine, softwood timber is being more seriously depleted than hardwood.

Cutting intensity varies locally, of course, and in some sections sawtimber growth exceeds the annual cut. In western Tennessee the volume of sawtimber appears to be slowly increasing because of an excess of both hardwood and softwood growth over the annual cut; the softwood increase, however, is mainly small second-growth cypress of limited commercial value. In the Cumberland Plateau, hardwood sawtimber is likewise increasing although softwood is declining; this seems to indicate that hardwoods are replacing the more desirable pine.

Analysis of hardwood sawtimber volume trends must be tempered by a consideration of grade and species. Much of the sawtimber is cut from good-quality logs whereas most of the growth is on low-quality logs (grade 3 and tie and timber logs), some of which have little prospect of improving in grade. Moreover, this downgrading is intensified by species selection. Distinctly high-value species as such yellow-poplar and white oak are being cut more heavily than low-value species—hickory and blackgum, for example.

These trends, should they continue, will result in an even tighter supply of high-quality timber and pose a serious problem to the State's wood-using industries.

Tennessee's Timber Needs

How much timber should Tennessee grow to meet its long-range needs? Although an immediate goal is to grow enough to satisfy the demands of the present wood-using industries, a more foresighted objective is necessary to anticipate the future demands of the State's growing population and expanding industrial economy. Attaining an increased level of growth

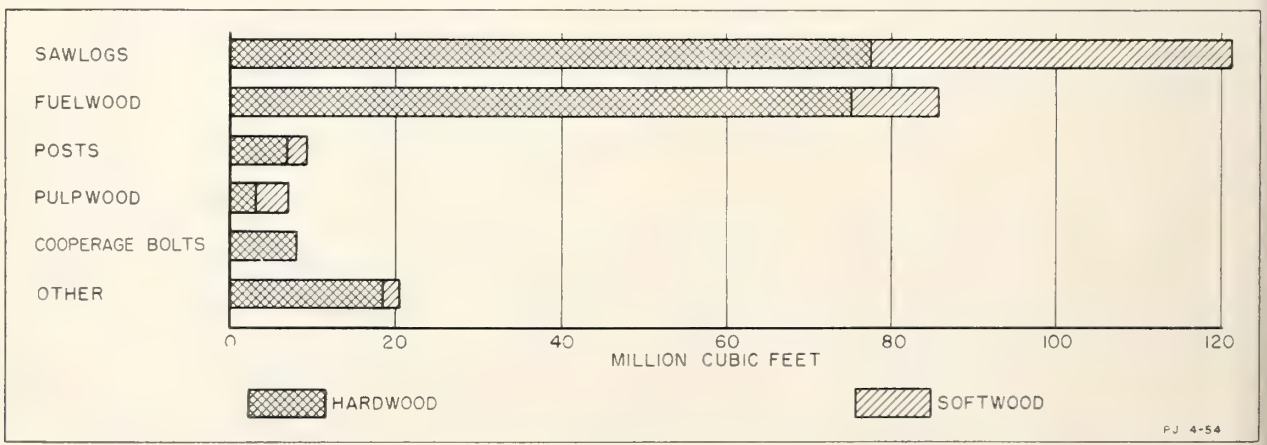

FIGURE 30.—*Annual cut of growing stock, 1949.*

would, in the long run, result in substantially more income and employment.

Taking into account the acreage of commercial forest land in Tennessee and other States, the potential rate of growth in the principal types, local accessibility of the timber, ease of management, and position with respect to consumer markets, it is estimated that a reasonable growth goal for Tennessee might be about 600 million cubic feet of timber annually, including 2.2 billion board-feet of sawtimber. This approximates 49 cubic feet of growing stock and 178 board-feet of sawtimber growth per acre per year. Since growth now averages 23 cubic feet per acre annually for growing stock and 71 board-feet for sawtimber, to achieve this goal would mean more than doubling present average growth.

Obviously there is a considerable element of judgment in formulating any goals for timber products. But whether the suggested goal is several notches high or low does not alter the general character of the action needed to build up the forest resources of Tennessee.

Meeting Tennessee's Timber Needs

THE GREAT majority of Tennessee's timberlands are without management, or are still in the early stages of transition from unmanaged to managed forests. Much of their present condition stems from their past use, and similarly much of their future hinges upon present and future treatment. Though interest in the growing of timber is increasing, a great deal remains to be accomplished before the forests are fully developed.

Tennessee has the timber-producing potential, the markets, and the leadership necessary to develop a more productive timber economy. These are the ingredients for creating an abundance of timber that will lead to more jobs and greater economic returns from the forest. It is not the function of this report to detail the forestry program needed to develop this more productive economy, but the findings of the Forest Survey throw light on some of the approaches to a better forest situation.

Protection

Adequate protection of the forest is essential in building up and maintaining the timber resource.

Fire Control

During the past 20 years, two-thirds of the State has been placed under organized fire protection largely through joint State-Federal financing. The current goal in the State is to hold the annual burn to less than 0.5 percent of the area protected. In the 5-year period 1947–51, the annual burn on State-protected land averaged 1.0 percent. In 1951, the burn was held to the lowest percentage on record—0.56 percent. This excellent record was broken in 1952 when an abnormal, prolonged drought produced an extremely hazardous fire situation, and 13 percent of the protected area burned. More than 1.5 million acres of timberland burned that year with an estimated damage of over 7 million dollars (fig. 31).

Not only is one-third of the State unprotected, but present facilities in protected areas are still inadequate, particularly when blow-up conditions as in 1952 occur. Tennessee needs additional equipment, manpower, funds, and training of fire fighters if losses from fire are not to exceed the current objective of protection.

Grazing Control

At least one-third of Tennessee's farm woodland is grazed. As frequently practiced, grazing is so heavy that it destroys seedlings, particularly of the most valuable species such as yellow-poplar. It also injures tree roots, slows the growth of large trees, destroys humus and litter, and reduces the ability of the soil to absorb water (fig. 32). In hardwood timber types such as predominate in Tennessee, the weight of professional opinion is on the side of separating grazing from timber production.

The means for grazing protection were greatly improved in 1948 when the State made it unlawful to run livestock at large. It is true that some stockowners now graze their own woodlands more heavily than before, since they are denied access to the land of others. However, the landowner who desires to practice forestry has legal recourse, and in general no longer need contend with his neighbors' hungry cattle. The law is one more step in the recognition of timber as a crop.

Forest Pest Control

A large part of the damage to merchantable timber from insects and disease can be traced to earlier fire injuries that permit the entrance of wood-destroying

FIGURE 31.—*Forest fires take a heavy annual toll of timber. (Tenn. Conservation Dept. photo.)*

fungi and insect pests. But landowners are also faced with insect and disease attacks that are not associated with fire. Bark beetles often attack pines that have been weakened by serious drought. Blister rust is a constant threat to white pine. Littleleaf disease is a menace to shortleaf pine, although thus far it appears to have caused only minor damage in Tennessee. There is also a possible serious threat from oak wilt, a fungus disease that attacks all species of oak and which may have the potentiality of damage rivaling that caused earlier by the chestnut blight. Improved facilities are needed to assure early detection and prompt action to suppress outbreaks of insects and diseases. While control measures have not been formulated for all destructive agents, prompt utilization of affected trees can aid in holding losses to a minimum.

Cull Hardwood Removal

In Tennessee's forests, three-tenths of the trees 5 inches in d. b. h. and larger are culls—virtually all hardwoods. Some of these cull trees can be used profitably for fuel, fence posts, or pulpwood. But the quantity is so large and the problem so general that additional investment in girdling or otherwise killing cull trees is needed if potential growing space is to be made available for thrifty merchantable trees (fig. 33).

Removal of cull hardwoods is a job for the individual landowner. Owners placing timberlands under management have generally been quick to see the advantage of increasing their effective growing space. But so far, cull hardwoods have been removed from only a small part of Tennessee's forests.

FIGURE 32.—*Overgrazing damages soil and timber. The woodland to the left of the fence has been protected from grazing; the one to the right of it has been heavily grazed. (TVA photo.)*

Forest Planting

Another important way of more fully utilizing the capacity of Tennessee's forest lands is by tree planting. There are 1.2 million acres of commercial forest in Tennessee that are either nonstocked or so poorly stocked with commercial tree species that they must be classed as idle. With protection, some of this area will restock naturally, but it is estimated that about 940 thousand acres with insufficient seed source would require planting if it is to be restored to productivity within a reasonable period. In addition, there are extensive areas in the Highland Rim and Cumberland Plateau stocked with low-valued hardwoods; here interplanting with pine (and yellow-poplar on some sites), if accompanied by hardwood control, would improve the existing timber stand.

Substantial progress on the planting job has been made within the State—a quarter of a million acres have been planted. In a number of counties, civic groups, banks, and industries have purchased mechanical tree planters for loan to farmers and other small landowners (fig. 34). The prospects of early income from pine plantations appear assured by an expanding pulpwood market resulting from the establishment of new pulp mills in the State and bordering areas. A market for treated pine fence post material also is developing within the State. This is a promising outlet for pine timber too small for pulpwood. All of these developments should help to stimulate greater interest in planting.

Better Utilization

Wood-using industries have made many adjustments over the years to accommodate their production to the changing timber resource. Additional adjustments can help extend the resource even further. A striking example is the opportunity of utilizing for pulpwood the tree tops usually left in the woods after

FIGURE 33.—*Deadening cull hardwoods makes more space available to thrifty merchantable growth. (Tenn. Conservation Dept. photo.)*

pine sawlogs are cut. A year's accumulation of usable pine tops in Tennessee's forests is equal to about three-tenths of the State's pulpwood production. Another opportunity for extending the resource lies in using chipped sawmill slabs and edgings for pulp and hardboard.

Using each tree cut for the most valuable product or products it will yield will also help to extend the available resource. A case in point is the desirability of shifting the bulk of the fuelwood—which amounts to more than one-third of the total annual cut—to such widely available sources as cull trees, tops of trees cut for other uses, and sawmill slabs that ar now not fully utilized. This would materially reduce the cutting pressure on Tennessee's forests and permit the use of growing stock for more valuable products. Similarly, hardwood timber suitable for high-quality products such as veneer logs need not be cut for sawlogs or other lower value products. One way of attaining this latter objective is by integrated logging, i. e., harvesting several products during a logging operation so that the various portions of the cut are channeled to those uses that will insure the greatest economic return.

FIGURE 34.—*Two men with a farm tractor and mechanical tree planter can set 5 to 8 acres to pine in a day. (Tenn. Conservation Dept. photo.)*

Efficient manufacture of timber products can also reduce wood waste. The most pressing need along this avenue is improving the operating efficiency of the several thousand circular sawmills that process the bulk of Tennessee's timber. The Division of Forestry Relations of the Tennessee Valley Authority has done much educational work to help sawmill operators reduce both the mis-manufacture of lumber and the costs of mill operation. The keen interest in this program shown by sawmill operators is encouraging. Continued efforts are needed, however.

Intensified Forest Management

While protection, cull hardwood removal, and planting are important components of management, it is also essential that timber harvesting be carried out so as to leave the forest in condition for high, continuous yields of timber (figs. 35, 36). The common practice in Tennessee of selling unmarked timber by the boundary and accepting a lump-sum payment is hardly conducive to improved management, since it leaves the buyer (generally a small sawmill operator) free to cut what he pleases from a given acreage of timber.

In a State characterized by a multiplicity of small ownerships, improving the level of harvesting methods is not easy. About 85 percent of the private forest acreage in Tennessee is held by 180,000 owners in holdings of less than 5,000 acres; the bulk of the remaining acreage is in holdings of less than 50,000 acres. Increasing numbers of forest landowners are placing their forest lands under management. But most individuals are uninterested or unable to practice forestry or are uninformed as to the techniques for most profitably managing their timber. Free technical assistance from both public and industrial foresters is available on a limited scale to interested landowners. But the demand for management assistance to inform and aid forest landowners is greater than can be supplied with the available forestry personnel.

FIGURE 35. —*Destructive harvesting practice. This forest has been stripped of virtually all merchantable timber.* (*Tenn. Conservation Dept. photo.*)

Poor cutting practices in Tennessee, particularly in the small ownership class, is sometimes associated with a lack of suitable forest credit facilities—i. e., long-term loans at low interest rates using land under management for continuous production of timber crops as collateral security. A sound system of forest credit would enable landowners to avoid premature liquidation and consequent reduction in the earning capacity of the forest. A forest credit system might also foster the consolidation of small holdings into units of more economic size, and stimulate the flow of investment capital into forest enterprises.

Recent legislation permits national banks to make real estate loans on forest tracts under good management; loans may run for 10 years if provision is made for amortization, or for 2 years without such provision. Certain life insurance companies are now making long-term loans on larger managed properties. For most owners, however, adequate long-term forest credit facilities are not available.

Forest insurance may also encourage investment in timber growing by making invested capital more secure, and thus help promote better forest management and fire protection.

FIGURE 36.—*Good harvesting practice. An adequate residual stand of merchantable timber has been left for future growth. (Tenn. Conservation Dept. photo.)*

The Forest Future

Most owners of small holdings that make up the great bulk of Tennessee's forests are still uninterested in the opportunities or uninformed as to the methods of improving the timber resource. This is reflected in current resource conditions: the quality of merchantable timber is low; sawtimber is concentrated in the smaller tree sizes; the volume in cull timber is heavy; and timber growth is far below its potential.

But prospects for better forestry are encouraging. New or expanded markets are developing for several products—pine pulpwood, hardwood pulpwood, pine fence posts, and chipped sawmill residues. Through the efforts of public and private forestry agencies, many forest landowners and timber operators are taking increased interest in improved forest management and utilization methods. Wide acceptance and application of the constructive measures called for in this section—adequate forest protection, cull hardwood removal, forest planting, better utilization, and improved harvesting practices—will go a long way toward bettering the overall forest situation in Tennessee.

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Appendix

The Field Survey and Its Accuracy

Forest Land Area and Timber Volume

THE ESTIMATES of forest acreage and timber volume are based upon a systematic sampling system involving a forest-nonforest classification on aerial photographs and on-the-ground measurement of quarter-acre sample plots. The sample plots were taken in pairs at and near the intersections of a grid of east-west and north-south lines spaced 3 miles apart. Field work in the State was begun in July 1948 and completed in October 1950.

Accuracy of the estimates may be affected by two types of errors. The first type stems from the use of a sample to estimate the whole and from variability of the item being sampled. This type is termed sampling error; it is susceptible to a mathematical evaluation of the probability of error. The second type of error derives from human mistakes in measurement, judgment, arithmetic, or recording, and from limitations of method or equipment. Effects of this second type of error—often referred to as reporting and estimating error—are not susceptible to a mathematical appraisal, but the Forest Survey constantly attempts to hold such errors to a minimum by proper training and good supervision, and by emphasis on careful work.

Statistical analysis of the data, using random-sampling formulas, indicates a sampling error of 0.4 percent for the State estimate of total forest area, 1.7 percent for total cubic-foot volume, and 2.3 percent for total board-foot volume. However, because a systematic sample is generally more efficient than a random sample of the same size, these estimates of sampling error may be considered as setting an upper limit of error, rather than as expressing the actual probability of error.

As the State total acreage and volumes are broken down by Survey region, county, forest type, species, and other subdivisions of the data, the possibility of error increases and is greatest for the smallest items. The order of this increase is suggested in table 7.

TABLE 7.—*Maximum sampling error to which Survey estimates of Tennessee's forest area, cubic-foot volume, and board-foot volume may be liable* [1]

Commercial forest		Growing stock		Sawlog growing stock	
Area	Sampling error	Total	Sampling error	Total	Sampling error
Thousand acres	*Percent*	*Million cu. ft.*	*Percent*	*Million bd.-ft.*	*Percent*
12,500	0.4	6,000	1.7	16,000	2.3
5,000	.6	3,000	2.3	10,000	2.9
2,000	1.0	1,000	4.1	3,000	5.4
500	2.0	400	6.4	1,000	9.3
50	6.4	40	20.3	100	29.3

[1] Liable on a probability of 2 chances out of 3.

Growth

Gross growth estimates are based on radial-growth measurements of mechanically sampled trees on Forest Survey plots. Measured growth over the past 10 years was used for projecting growth 10 years ahead. The difference between present and projected volume of the sample trees was reduced to an average annual percentage increase and applied directly to the current inventory volume. Net growth was calculated by subtracting from gross growth an allowance for mortality based on the plot inventory of trees that had died in the previous 4 years. No attempt was made to calculate sampling error in the growth estimates.

Production and Annual Cut

Annual cut estimates are conversions of production estimates. Sawlog production in 1949 was estimated from a survey of lumber production conducted by the U. S. Bureau of the Census. For other commodities a canvass of 1949 timber production was conducted by the Forest Service, with some assistance from the Division of Forestry Relations of the Tennessee Valley Authority. Commercial log and bolt production, other than for lumber, was obtained by a 100-percent canvass of establishments or producers. Production

of fuelwood and fence posts, and timber for miscellaneous domestic use on farms was estimated from an area sample. The data on production of each commodity were converted to annual cut of growing stock by using timber cut-to-production ratios derived from measurements taken on sample cutting areas.

The sampling errors to which the State cubic-foot estimates of annual cut are liable, on a probability of 2 chances out of 3, is shown in the following tabulation.

Commodity:	*Sampling error of cubic-foot annual cut (percent)*
Sawlogs	12.2
Veneer logs	5.2
Cooperage bolts	10.0
Pulpwood	2.2
Fuelwood	22.5
Chemical wood	4.1
Poles and piling	1.9
Posts	18.6
Hewn ties	6.0
Mine timbers	1.3
Miscellaneous logs and bolts	5.4
All commodities	9.0

Public Forest-Land Ownership

The area under Federal jurisdiction was obtained from the various supervising agencies. State acreage was furnished by the Tennessee Division of Forestry. County and municipal ownership within the Tennessee Valley was supplied by the TVA Division of Forestry Relations; acreage for other counties and municipalities by the Tennessee Division of Forestry.

Definitions of Terms

Forest Land

FOREST LAND.—Includes (*a*) land which is at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (*b*) land from which the trees have been removed to less than 10-percent stocking and which has not been developed for other use; and (*c*) afforested areas.

COMMERCIAL FOREST LAND.—Forest land which is (*a*) producing, or is physically capable of producing, usable crops of wood (usually sawtimber), (*b*) economically available now or prospectively, and (*c*) not withdrawn from timber utilization.

NONCOMMERCIAL FOREST LAND.—Forest land (*a*) withdrawn from timber utilization through statute, ordinance, or administrative order but which otherwise qualifies as commercial forest land and (*b*) incapable of yielding usable wood products (usually sawtimber) because of adverse site conditions, or so physically inaccessible as to be unavailable economically in the forseeable future.

Tree Species

COMMERCIAL SPECIES.—Includes species that normally have value for commercial timber products; excludes so-called weed or noncommercial species such as blackjack oak, scrub post oak, blue beech, sourwood, etc.

SOFTWOODS.—Southern pines, principally shortleaf (*Pinus echinata*) and Virginia (*P. virginiana*); white pine (*P. strobus*); hemlock (*Tsuga canadensis*); redcedar (*Juniperus virginiana*); and cypress (*Taxodium distichum*).

HARDWOODS.—Broadleaved species, of which the most numerous genera or species are the oaks (*Quercus* spp.); hickories (*Carya* spp.); and yellow-poplar (*Liriodendron tulipifera*).

Forest Type

Forest type classifications in Tennessee were based upon the number of sound well-formed dominant and codominant trees. Standard Forest Survey types that roughly approximate those defined locally in Tennessee are indicated parenthetically.

SOUTHERN YELLOW PINE (LOBLOLLY-SHORTLEAF PINE AND OAK-PINE).—Stands in which southern pines comprise at least 25 percent of the typing trees.

CEDAR (LOBLOLLY-SHORTLEAF PINE AND OAK-PINE).—Stands in which redcedar comprises at least 25 percent of the typing trees.

OTHER SOFTWOOD (WHITE-RED-JACK-PINE).—Stands in which softwood species other than southern pines or redcedar comprise at least 25 percent of the typing trees. The principal species are white pine and hemlock.

BOTTOM-LAND HARDWOOD (OAK-GUM-CYPRESS AND ELM-ASH-COTTONWOOD).—Stands in which bottomland hardwoods and cypress comprise 76 percent or more of the typing trees.

UPLAND HARDWOOD (OAK-HICKORY AND MAPLE-BEECH-BIRCH).—Stands in which upland hardwoods

comprise 76 percent or more of the typing trees, and no pine is present.

Upland hardwood-pine (oak-hickory and maple-beech-birch).—Stands in which upland hardwoods comprise 76 percent or more of the typing trees, and some pine is present.

Class of Timber

Sawtimber trees.—Live trees of commercial species at least 9.0 inches d. b. h. in softwoods and 11.0 inches d. b. h. in hardwoods, that contain at least a 12-foot merchantable butt log—or, if the butt log is a cull, at least 50 percent of the gross sawlog volume is in merchantable logs. To be merchantable, a log must meet the following requirements:

(a) In softwoods, logs having a minimum 6-inch small-end diameter inside bark, 8 feet long, and at least one-third sound, with sweep or crook not exceeding two-thirds the small-end diameter. Cedar logs must have sound heartwood.

(b) In hardwoods, logs having a minimum 8-inch small-end diameter inside bark, 8 feet long, and which meet the specifications of a standard lumber log or a tie and timber log.

Poletimber trees.—Trees of commercial species which meet regional specifications of soundness and form, and which are of the following diameters at breast height: softwoods 5.0 to 9.0 inches; hardwoods 5.0 to 11.0 inches. (Such trees will usually become sawtimber trees if left to grow.)

Seedling and sapling trees.—Live trees of commercial species less than 5.0 inches in diameter at breast height and of good form and vigor.

Cull trees.—Live trees of sawtimber or poletimber size that are unmerchantable for sawlogs now or prospectively because of defect, rot, or species.

Rotten cull trees.—Live trees of sawtimber or poletimber size which fail to meet regional specifications of proportion of sound volume to total volume.

Sound cull trees.—Live trees of sawtimber or poletimber size which meet regional specifications of freedom from rot but will not make at least one merchantable sawlog now or prospectively according to regional specifications because of roughness, poor form, or species.

Stand-Size Class

Large sawtimber.—Stands with sawtimber trees having a minimum net volume per acre of 1,500 board-feet, International ¼-inch rule, and at least half of this volume in softwoods 15.0 inches d. b. h. and larger, and in hardwoods 17.0 inches d. b. h. and larger.

Small sawtimber.—Stands with sawtimber trees having a minimum net volume per acre of 1,500 board-feet, International ¼-inch rule, but which do not meet the specifications for large sawtimber.

Poletimber.—Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger (5.0 inches d. b. h. and larger) trees and with at least half the minimum stocking in poletimber trees.

Seedling and sapling.—Stands not qualifying as either sawtimber or poletimber stands, but having at least 10-percent stocking of trees of commercial species and with at least half the minimum stocking in seedling and sapling trees.

Nonstocked and other areas.—Commercial forest land not qualifying as sawtimber, poletimber, or seedling and sapling stands.

Tree Stocking

Stocking is the extent to which growing space is effectively utilized by present or potential growing-stock trees of commercial species. Stands are considered to be well stocked when the percentage of full stocking is 70 or above, medium stocked when the percentage is 40 to 69, poorly stocked when the percentage is 10 to 39, and nonstocked when the percentage is under 10.

Volume

Sawtimber volume.—Net volume in board-feet, International ¼-inch rule, of live sawtimber trees to a specified merchantable top.

Growing stock.—Net volume in cubic feet of live sawtimber and live poletimber trees from stump to a minimum 4.0-inch top diameter (of central stem) inside bark.

All-timber volume.—Net volume in cubic feet of live and salvable dead sawtimber and poletimber trees of commercial species, and cull trees of all species, from stump to a minimum 4.0-inch top d. i. b. Includes bole only of softwoods but both bole and limbs of hardwoods to a minimum 4.0-inch diameter inside bark.

Diameter and Basal Area

D. b. h. (diameter breast high).—Tree diameter in inches, outside bark, at 4½ feet above ground.

DIAMETER CLASS.—The 2-inch diameter classes extend from 1.0 inch below to 0.9 inch above the stated midpoint. Thus, the 12-inch class includes trees 11.0 inches to and including 12.9 inches d. b. h.

BASAL AREA.—Cross-sectional area, including bark, of trees at breast height, measured in square feet.

Growth

NET ANNUAL GROWTH OF SAWTIMBER.—The change during a specified year in net board-foot volume of live sawtimber on commercial forest land resulting from natural causes.

NET ANNUAL GROWTH OF GROWING STOCK.—The change during a specified year in net cubic-foot volume of growing stock on commercial forest land resulting from natural causes.

Annual Cut

ANNUAL CUT OF SAWTIMBER.—The net board-foot volume of live sawtimber trees cut or killed by logging on commercial forest land during a specified year.

ANNUAL CUT OF GROWING STOCK.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging on commercial forest land during a specified year.

Softwood Tree Grades

GRADE 1 (SMOOTH [8] TREES).—Not less than 20 feet of clear bole and at least 40 percent of the merchantable length clear of limbs and knots in sections not less than 8 feet in length. All cedar sawtimber trees were graded as No. 1.

GRADE 2 (LIMBY TREES).—Not less than 12 feet of clear bole and 25 to 39 percent of the merchantable length clear of limbs and knots in sections not less than 8 feet in length.

GRADE 3 (ROUGH TREES).—Merchantable trees below grade 2 specifications.

Hardwood Log Grades for Standard Lumber Logs [9]

GRADE 1.—Logs having five-sixths or more of their length on the 3 best faces in clear-cuttings not less than 5 feet long; they yield, on the average, at least 65 percent of their volume in No. 1 Common and better grades of lumber.

GRADE 2.—Logs having two-thirds to five-sixths of their entire length on the 3 best faces in clear-cuttings not less than 3 feet long; they yield, on the average, at least 40 percent of their volume in No. 1 Common and better grades of lumber.

GRADE 3.—Logs below grade 2, having one-half or more of their entire length on the 3 best faces in clear-cuttings not less than 2 feet long; they yield, on the average, at least 13 percent of their volume in No. 1 Common and better grades of lumber.

Hardwood Tie and Timber Log Specifications

Logs which do not meet the clear-cutting requirements of standard lumber logs, but which are sound, reasonably straight, and without large knots or knot clusters; they are suitable for ties and low-grade structural timbers.

Stand Quality

FAIR AND BETTER.—A stand in which at least four grade 2 or better hardwood logs or softwood trees are present per acre.

POOR.—A stand in which fewer than four grade 2 or better hardwood logs or softwood trees are present per acre.

Supplemental Tables

The tables that follow present additional statistical data, and include the standard Forest Survey tables which make it possible to compare or compile forest statistics for a group of States.

TABLE 8.—*Land area, by major classes of land, Tennessee, 1948–50*

Class of land	Area
	Thousand acres
Forest:	
Commercial	12,353.8
Noncommercial:	
Productive—reserved	253.8
Unproductive	
Total	12,607.6
Nonforest [1]	14,247.4
Total, all classes	26,855.0

[1] Includes some acreage of water according to Survey standards of area classification but defined by the Bureau of Census as land.

[8] Except as noted in the case of cedar.

[9] For detailed external specifications of log grades used, see Forest Service Committee on Interim Hardwood Sawlog Grades, "Interim sawlog grades for southern hardwoods," Southern Forest Experiment Station, 9 pp., illus. Rev. 1948.

TABLE 9.—*Total land area and commercial forest land area in Tennessee, by county, 1948–50*

County	All land	Commercial forest		County	All land	Commercial forest	
	Thousand acres	*Thousand acres*	*Percent*		*Thousand acres*	*Thousand acres*	*Percent*
Anderson	216.3	136.4	63.1	Lawrence	405.8	174.0	42.9
Bedford	308.5	77.7	25.2	Lewis	182.4	137.4	75.3
Benton	275.2	146.0	53.1	Lincoln	371.8	139.8	37.6
Bledsoe	258.6	186.9	72.3	Loudon	153.6	54.9	35.7
Blount	373.8	119.4	31.9	McMinn	278.4	106.7	38.3
Bradley	216.3	94.8	43.8	McNairy	364.2	139.0	38.2
Campbell	286.1	216.8	75.8	Macon	194.6	79.4	40.8
Cannon	173.4	78.5	45.3	Madison	359.0	113.4	31.6
Carroll	381.4	133.4	35.0	Marion	324.4	249.5	76.9
Carter	227.2	138.7	61.0	Marshall	241.3	78.2	32.4
Cheatham	195.2	126.4	64.8	Maury	392.9	117.5	29.9
Chester	182.4	67.8	37.2	Meigs	136.3	58.9	43.2
Claiborne	284.8	160.4	56.3	Monroe	425.6	252.4	59.3
Clay	169.0	78.6	46.5	Montgomery	347.5	125.1	36.0
Cocke	277.8	127.4	45.9	Moore	78.1	30.2	38.7
Coffee	278.4	131.7	47.3	Morgan	344.9	285.8	82.9
Crockett	172.2	26.8	15.6	Obion	352.0	94.0	26.7
Cumberland	434.5	360.9	83.1	Overton	282.9	144.8	51.2
Davidson	340.5	126.3	37.1	Perry	268.2	192.2	71.7
Decatur	221.4	125.5	56.7	Pickett	111.4	68.7	61.7
DeKalb	202.9	100.4	49.5	Polk	279.0	202.7	72.7
Dickson	311.0	141.2	45.4	Putnam	261.2	127.3	48.7
Dyer	337.3	105.3	31.2	Rhea	214.4	119.9	55.9
Fayette	450.5	117.5	26.1	Roane	242.6	114.6	47.2
Fentress	319.4	229.2	71.8	Robertson	303.4	76.8	25.3
Franklin	359.0	184.1	51.3	Rutherford	403.2	123.9	30.7
Gibson	388.5	66.4	17.1	Scott	351.3	297.4	84.7
Giles	396.1	120.4	30.4	Sequatchie	174.7	139.8	80.0
Grainger	198.4	83.3	42.0	Sevier	385.9	123.3	32.0
Greene	394.8	134.7	34.1	Shelby	480.6	113.6	23.6
Grundy	229.1	188.9	82.5	Smith	208.0	88.4	42.5
Hamblen	111.4	29.2	26.2	Stewart	309.8	208.7	67.4
Hamilton	368.6	174.9	47.4	Sullivan	273.9	94.3	34.4
Hancock	147.8	78.7	53.2	Sumner	353.3	124.4	35.2
Hardeman	419.2	178.4	42.6	Tipton	293.1	73.4	25.0
Hardin	380.8	221.9	58.3	Trousdale	74.2	24.7	33.3
Hawkins	316.2	142.1	44.9	Unicoi	118.4	87.9	74.2
Haywood	332.2	89.3	26.9	Union	135.7	71.8	52.9
Henderson	329.6	119.2	36.2	Van Buren	163.2	134.7	82.5
Henry	383.4	130.0	33.9	Warren	282.9	120.3	42.5
Hickman	392.3	249.3	63.5	Washington	209.3	67.9	32.4
Houston	132.5	86.3	65.1	Wayne	474.2	342.7	72.3
Humphreys	355.2	223.1	62.8	Weakley	368.6	86.6	23.5
Jackson	209.3	87.5	41.8	White	246.4	121.6	49.4
Jefferson	203.5	54.3	26.7	Williamson	380.2	134.5	35.4
Johnson	191.4	115.5	60.3	Wilson	371.2	133.2	35.9
Knox	330.9	112.4	34.0				
Lake	105.0	25.1	23.9	State	26,855.0	12,353.8	46.0
Lauderdale	311.7	108.5	34.8				

TABLE 10.—*Commercial forest land area, by ownership and stand-size classes, Tennessee, 1948–50*

Ownership class	Total	Sawtimber stands	Poletimber stands	Seedling and sapling stands [1]	Nonstocked and other areas [1]
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Federally owned or managed:					
National forest	563.3	219.7	298.5	45.1	
Other	252.7	99.2	135.3	18.2	
Total	816.0	318.9	433.8	63.3	
State	287.7	(2)	(2)	(2)	
County and municipal	10.0	(2)	(2)	(2)	
Private:					
Farm	5,053.1	(2)	(2)	(2)	
Industrial and other	6,187.0	(2)	(2)	(2)	
Total	11,240.1	2,550.1	6,961.3	1,728.7	
All ownerships	12,353.8	2,928.5	7,585.7	1,839.6	

[1] Nonstocked and other areas not classified elsewhere are included with seedling and sapling stands.
[2] Detailed breakdown by stand-size class not available.

TABLE 11.—*Commercial forest land area in Tennessee, by stand size and forest type, 1948–50*

Forest type	All stand sizes	Large sawtimber	Small sawtimber	Poletimber	Seedling and sapling	Nonstocked and other areas
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Softwood types:						
Southern yellow pine	2,033.5	69.5	445.2	1,255.7	235.0	28.1
Cedar	893.8	10.4	14.6	565.4	282.2	21.2
Other softwoods	108.1	26.5	27.8	46.1	7.7	
Total	3,035.4	106.4	487.6	1,867.2	524.9	49.3
Hardwood types:						
Bottom-land hardwood	921.9	107.5	273.1	458.8	76.9	5.6
Upland hardwood	6,334.3	477.9	1,085.2	3,896.7	807.3	67.2
Upland hardwood-pine	2,062.2	125.9	264.9	1,363.0	272.8	35.6
Total	9,318.4	711.3	1,623.2	5,718.5	1,157.0	108.4
All types	12,353.8	817.7	2,110.8	7,585.7	1,681.9	157.7

TABLE 12.—*Commercial forest land in Tennessee, by forest type and Survey region, 1948–50*

Forest type	State	West	West-Central	Central	Plateau	East
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Softwood types:						
Southern yellow pine	2,033.5	67.6	74.8		787.4	1,103.7
Cedar	893.8	15.8	64.6	646.0	97.7	69.7
Other softwood	108.1				38.7	69.4
Total	3,035.4	83.4	139.4	646.0	923.8	1,242.8
Hardwood types:						
Bottom-land hardwood	921.9	733.4	66.8	71.9	37.3	12.5
Upland hardwood	6,334.3	867.0	1,651.8	1,591.0	1,367.5	857.0
Upland hardwood-pine	2,062.2	103.9	249.1	35.9	728.1	945.2
Total	9,318.4	1,704.3	1,967.7	1,698.8	2,132.9	1,814.7
All types	12,353.8	1,787.7	2,107.1	2,344.8	3,056.7	3,057.5

TABLE 13.—*Area of commercial forest land, by major forest types, Tennessee, 1948–50*

Forest type	Thousand acres	Forest type	Thousand acres
White-red-jack pine	81.1	Oak-gum-cypress	846.1
Longleaf-slash pine	3.0	Elm-ash-cottonwood	75.8
Loblolly-shortleaf pine	2,189.2	Maple-beech-birch	501.6
Oak-pine	762.1		
Oak-hickory	7,894.9	Total	12,353.8

TABLE 14.—*Commercial forest land area in Tennessee, by degree of tree stocking and forest type, 1948–50*

Forest type	All stocking	Well stocked	Medium stocked	Poorly stocked	Nonstocked
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Softwood types:					
Southern yellow pine	2,033.5	1,428.3	482.8	94.3	28.1
Cedar	893.8	306.3	406.0	160.3	21.2
Other softwoods	108.1	60.5	32.7	14.9	----
Total	3,035.4	1,795.1	921.5	269.5	49.3
Hardwood types:					
Bottom-land hardwood	921.9	414.0	394.7	107.6	5.6
Upland hardwood	6,334.3	3,526.6	2,210.0	530.5	67.2
Upland hardwood-pine	2,062.2	1,387.8	534.9	103.9	35.6
Total	9,318.4	5,328.4	3,139.6	742.0	108.4
All types	12,353.8	7,123.5	4,061.1	1,011.5	157.7

TABLE 15.—*Area of sawtimber stands in Tennessee, by stand quality and forest type, 1948–50*

Forest type	All qualities	Fair or better	Poor	Forest type	All qualities	Fair or better	Poor
	Thousand acres	*Thousand acres*	*Thousand acres*		*Thousand acres*	*Thousand acres*	*Thousand acres*
Softwood types:				Hardwood types:			
Southern yellow pine	514.7	170.1	344.6	Bottom-land hardwood	380.6	152.8	227.8
Cedar	25.0	25.0	----	Upland hardwood	1,563.1	655.5	907.6
Other softwood	54.3	14.2	40.1	Upland hardwood-pine	390.8	177.3	213.5
Total	594.0	209.3	384.7	Total	2,334.5	985.6	1,348.9
				All types	2,928.5	1,194.9	1,733.6

TABLE 16.—*Basal area per acre of growing stock and cull trees in Tennessee, by forest type and Survey region, 1948–50*

Forest type	State	West	West-Central	Central	Plateau	East
	Square feet	*Square feet*	*Square feet*	*Square feet*	*Square feet*	*Square feet*
Softwood types:						
Growing stock	30.0	29.7	27.4	17.7	30.0	36.9
Cull trees	9.2	7.6	8.0	11.5	10.5	7.2
Total	39.2	37.3	35.4	29.2	40.5	44.1
Bottom-land hardwood:						
Growing stock	43.1	42.3	42.9	43.2	51.9	65.0
Cull trees	28.5	29.7	21.5	25.5	28.3	14.6
Total	71.6	72.0	64.4	68.7	80.2	79.6
Upland hardwood: [1]						
Growing stock	31.8	31.5	28.6	33.9	31.0	34.3
Cull trees	13.2	15.3	10.7	14.6	14.8	11.6
Total	45.0	46.8	39.3	48.5	45.8	45.9
All types:						
Growing stock	32.3	35.8	29.0	29.7	30.9	35.5
Cull trees	13.3	20.9	10.8	14.1	13.7	9.8
Total	45.6	56.7	39.8	43.8	44.6	45.3

[1] Includes upland hardwood-pine.

TABLE 17.—*Distribution of growing stock in Tennessee, by species within each forest type, 1948–50*

Species	All types	Southern yellow pine	Cedar	Other soft-wood	Bottom-land hardwood	Upland hard-wood	Upland hardwood-pine
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Softwood:							
Loblolly pine	0.3	1.7	----	----	----	----	0.1
Shortleaf pine	6.6	34.6	0.1	0.5	----	(1)	4.9
Virginia pine	4.1	21.9	.3	4.2	(1)	(1)	2.4
Other southern yellow pines	1.1	5.2	----	.3	----	----	1.3
Cedar	1.4	.4	33.6	----	0.1	0.5	.4
Cypress	.9	----	----	----	8.0	(1)	----
White pine	.9	1.0	----	26.6	----	.2	1.4
Hemlock	.9	.1	.3	34.8	----	.4	.9
Total	16.2	64.9	34.3	66.4	8.1	1.1	11.4
Hardwood:							
Black, scarlet, and southern red oaks	16.1	10.9	7.3	5.7	2.0	19.8	21.6
Cherrybark, Shumard, and northern red oaks	5.1	1.0	4.7	.2	4.2	7.1	3.8
Water oaks	1.2	----	----	----	10.4	.2	----
White oaks	11.0	5.6	1.5	3.0	1.1	14.0	16.1
Other white oaks	10.2	6.6	6.5	2.8	4.8	11.2	15.6
Ash	1.5	.1	2.5	----	4.4	1.7	.4
Beech	1.7	.1	2.8	1.4	.5	2.6	1.0
Elms	2.3	.2	7.9	.6	7.6	2.2	.6
Pecan	.2	----	----	----	2.2	----	----
Other hickories	11.7	5.0	16.6	3.5	1.8	15.4	12.9
Other hard hardwoods	4.5	.6	10.5	.6	9.6	4.9	3.0
Sweetgum	3.5	.7	.5	.2	16.3	2.7	1.2
Black and tupelo gums	2.7	1.2	.2	1.5	6.3	2.6	3.2
Bay and magnolia	.2	----	----	.6	----	.4	.2
Cottonwood	.3	----	----	----	3.0	(1)	----
Maples	2.9	.7	1.2	2.4	4.7	3.4	2.9
Willow	1.0	----	----	----	8.8	.1	----
Yellow-poplar	6.5	2.3	3.4	6.3	1.7	9.2	5.5
Other soft hardwoods	1.2	.1	.1	4.8	2.5	1.4	.6
Total	83.8	35.1	65.7	33.6	91.9	98.9	88.6
All species	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Negligible.

TABLE 18.—*Total cordwood volume in Tennessee, by class of timber and species, 1948–50*

Species	All timber [1]	Growing stock				Hardwood limbs	Cull trees
		All trees	Sawtimber trees		Poletimber trees		
			Sawlog portion	Upper stem portion			
	Thousand cords [2]	*Thousand cords* [2]	*Thousand cords* [2]	*Thousand cords* [2]	*Thousand cords* [2]	*Thousand cords* [2]	*Thousand cords* [2]
Softwood:							
Southern pines	9,341	9,195	5,026	672	3,497	----------	146
Cedar	1,300	1,070	311	56	703	----------	230
White pine	737	710	511	68	131	----------	27
Hemlock	782	716	548	71	97	----------	66
Cypress	798	658	531	69	58	----------	140
Total	12,958	12,349	6,927	936	4,486	----------	609
Hardwood:							
Red oaks	25,481	19,152	9,067	3,466	6,619	2,399	3,930
White oaks	25,033	18,040	7,622	2,869	7,549	2,454	4,539
Hickories	12,681	9,997	3,917	1,457	4,623	914	1,770
Yellow-poplar	6,233	5,522	2,617	1,014	1,891	213	498
Sweetgum	3,658	3,004	1,326	503	1,175	226	428
Black and tupelo gums	4,043	2,337	1,115	416	806	436	1,270
Other hardwoods	26,477	13,621	5,542	2,100	5,979	2,631	10,225
Total	103,606	71,673	31,206	11,825	28,642	9,273	22,660
All species	116,564	84,022	38,133	12,761	33,128	9,273	23,269

[1] Sound volume in dead trees considered salvable is not included. This volume is as follows:

Region:	*Chestnut (thousand cords)*	*Other species (thousand cords)*
West	----------	42
West-Central	91	42
Central	106	74
Plateau	174	113
East	249	60
Total	620	331

[2] Softwood 75 cubic feet (i. b.) and hardwood 67 cubic feet (i. b.) per standard rough cord.

TABLE 19.—*Total cubic-foot volume in Tennessee, by class of timber and species, 1948–50*

Species	All timber [1]	Growing stock				Hardwood limbs	Cull trees
		All trees	Sawtimber trees		Poletimber trees		
			Sawlog portion	Upper stem portion			
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwood:							
Southern pines	700.6	689.6	376.9	50.4	262.3	----------	11.0
Cedar	97.6	80.3	23.4	4.2	52.7	----------	17.3
White pine	55.2	53.2	38.3	5.1	9.8	----------	2.0
Hemlock	58.7	53.7	41.1	5.3	7.3	----------	5.0
Cypress	59.9	49.4	39.8	5.2	4.4	----------	10.5
Total	972.0	926.2	519.5	70.2	336.5	----------	45.8
Hardwood:							
Red oaks	1,707.3	1,283.3	607.5	232.3	443.5	160.6	263.4
White oaks	1,677.3	1,208.7	510.7	192.2	505.8	164.5	304.1
Hickories	849.7	669.8	262.5	97.6	309.7	61.3	118.6
Yellow-poplar	417.5	370.0	175.3	68.0	126.7	14.2	33.3
Sweetgum	245.2	201.3	88.9	33.7	78.7	15.2	28.7
Black and tupelo gums	270.8	156.6	74.7	27.9	54.0	29.2	85.0
Other hardwoods	1,774.1	912.6	371.4	140.6	400.6	176.3	685.2
Total	6,941.9	4,802.3	2,091.0	792.3	1,919.0	621.3	1,518.3
All species	7,913.9	5,728.5	2,610.5	862.5	2,255.5	621.3	1,564.1

[1] Sound volume in dead trees considered salvable is not included. This volume is as follows:

Region:	*Chestnut (million cubic feet)*	*Other species (million cubic feet)*
West	----------	2.8
West-Central	6.1	2.8
Central	7.1	5.0
Plateau	11.6	7.6
East	16.7	4.0
Total	41.5	22.2

TABLE 20.—*Growing stock in Tennessee, by species and stand size, 1948–50*

Species	All stand sizes	Large sawtimber	Small sawtimber	Poletimber	Seedling and sapling	Nonstocked and other areas [1]
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwood:						
Southern pines	689.6	51.8	314.3	311.3	11.7	0.5
Cedar	80.3	7.1	6.9	62.7	3.6	----------
White pine	53.2	19.9	15.9	17.1	.3	----------
Hemlock	53.7	23.2	15.8	11.2	3.2	.3
Cypress	49.4	25.6	19.7	3.9	.2	----------
Total	926.2	127.6	372.6	406.2	19.0	0.8
Hardwood:						
Red oaks	1,283.3	253.2	391.0	616.4	21.9	0.8
White oaks	1,208.7	192.0	353.7	634.6	27.3	1.1
Hickories	669.8	80.7	192.0	383.2	13.7	.2
Yellow-poplar	370.0	67.2	144.2	153.4	5.2	----------
Sweetgum	201.3	31.8	90.0	76.3	2.9	.3
Black and tupelo gums	156.6	28.7	58.7	65.9	3.3	----------
Other hardwoods	912.6	180.5	294.0	409.9	26.0	2.2
Total	4,802.3	834.1	1,523.6	2,339.7	100.3	4.6
All species	5,728.5	961.7	1,896.2	2,745.9	119.3	5.4

[1] Includes areas not classified elsewhere.

TABLE 21.—*Growing stock volume in Tennessee, by species and Survey region, 1948–50*

Species	State	West	West-Central	Central	Plateau	East
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwood:						
Shortleaf pine	375.2	21.4	31.6	0.1	123.9	198.2
Virginia pine	235.7	.1	1.5		63.2	170.9
Other pines	131.9	1.2			9.6	121.1
Cedar	80.3	6.7	7.0	47.3	8.4	10.9
Other softwoods	103.1	48.9	.5		22.8	30.9
Total	926.2	78.3	40.6	47.4	227.9	532.0
Hardwood:						
Black, scarlet, and southern red oaks	922.0	130.6	176.8	158.8	223.6	232.2
Cherrybark, Shumard, and northern red oaks	291.7	47.8	59.0	60.8	67.4	56.7
Water oaks	69.6	37.0	8.3	11.2	9.8	3.3
White oak	628.1	61.0	181.0	102.5	133.8	149.8
Other white oaks	580.6	66.0	96.7	79.6	156.5	181.8
Hickories	669.8	80.8	112.3	150.8	191.7	134.2
Yellow-poplar	370.0	47.0	40.7	86.7	81.4	114.2
Sweetgum	201.3	125.0	33.9	25.6	7.7	9.1
Black and tupelo gums	156.6	41.5	19.9	20.2	47.4	27.6
Elms	133.2	51.3	11.5	46.8	13.5	10.1
Soft maples	97.5	20.4	6.1	9.6	28.3	33.1
Sugar maple	71.1	1.9	5.6	28.1	24.4	11.1
Ash	88.6	25.1	7.9	25.4	11.7	18.5
Beech	96.6	12.1	11.0	34.9	26.1	12.5
Walnut	72.3	3.4	7.9	31.0	9.2	20.8
Sycamore	43.4	19.9	6.1	8.5	6.9	2.0
Hackberry	31.0	16.4	1.3	11.1	.7	1.5
Other hardwoods	278.9	107.6	9.8	55.4	42.7	63.4
Total	4,802.3	894.8	795.8	947.0	1,082.8	1,081.9
All species	5,728.5	973.1	836.4	994.4	1,310.7	1,613.9

TABLE 22.—*Average volume per acre of growing stock in Tennessee, by forest type and Survey region, 1948–50*

Forest type	State	West	West-Central	Central	Plateau	East
	Cubic feet	*Cubic feet*	*Cubic feet*	*Cubic feet*	*Cubic feet*	*Cubic feet*
Softwood types:						
Southern yellow pines	474	392	471		385	542
Cedar	198	(1)	180	184	(1)	(1)
Other softwood	(1)				(1)	(1)
Total	406	392	336	184	395	539
Hardwood types:						
Bottom-land hardwood	662	651	623	691	(1)	(1)
Upland hardwood	479	503	393	511	487	549
Upland hardwood-pine	412	261	395	345	347	486
Total	482	552	401	515	443	520
All types	464	544	397	424	429	528

[1] Sample too small to be reliable.

TABLE 23.—*Net volume of live sawtimber and growing stock on commercial forest land, by stand-size class, Tennessee, 1948–50*

Stand-size class	Sawtimber	Growing stock
	Million board-feet	*Million cubic feet*
Sawtimber stands	10,354.7	2,857.9
Poletimber stands	5,547.2	2,745.9
Seedling and sapling stands	322.5	119.3
Nonstocked and other areas not elsewhere classified	15.6	5.4
Total	16,240.0	5,728.5

TABLE 24.—*Net volume of live sawtimber and growing stock on commercial forest land, by ownership class, Tennessee, 1948–50*

Ownership class	Sawtimber	Growing stock
	Million board-feet	*Million cubic feet*
Federally owned or managed:		
National Forest	1,163.8	347.8
Other	469.0	159.1
Total	1,632.8	506.9
State, county, and municipal	374.8	146.0
Private [1]	14,232.4	5,075.6
All ownerships	16,240.0	5,728.5

[1] Separation between farm, industrial, and other private ownership classes not available.

TABLE 25.—*Net volume of live sawtimber and growing stock on commercial forest land, by species, Tennessee, 1948–50*

Species	Sawtimber	Growing stock
	Million board-feet	*Million cubic feet*
Softwood:		
Shortleaf and loblolly pines	1,240.6	392.0
Other southern yellow pines	886.5	297.6
White and red pines	244.0	53.2
Hemlock	261.6	53.7
Cypress	249.7	49.4
Other eastern softwoods	132.4	80.3
Total	3,014.8	926.2
Hardwood:		
White oaks (*Quercus alba and prinus*)	1,834.6	671.0
Red oaks (*O. borealis, shumardii, and falcata* var. *pagodaefolia*)	895.9	291.7
Other white oaks	1,374.0	537.7
Other red oaks	2,982.7	991.6
Sugar maple	159.0	71.1
Soft maples	181.6	97.5
Beech	351.1	96.6
Sweetgum	562.0	201.3
Tupelo and blackgum	465.7	156.6
Ash	205.6	88.6
Hickory	1,652.9	683.3
Cottonwood and aspen	79.4	18.4
Basswood	79.7	23.2
Yellow-poplar	1,135.0	370.0
Black walnut	184.6	72.3
Other eastern hardwoods	1,081.4	431.4
Total	13,225.2	4,802.3
All species	16,240.0	5,728.5

TABLE 26.—*Net volume of live sawtimber on commercial forest land, by diameter class groups and species, Tennessee, 1948–50*

Species	Diameter class groups						Total
	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches and up	
	Million board-feet	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Southern yellow pines	681.0	582.7	439.9	221.6	106.1	95.8	2,127.1
White and red pines	27.5	37.3	37.1	27.6	29.2	85.3	244.0
Other eastern softwoods	77.8	105.3	81.0	71.2	62.2	246.2	643.7
White oaks (*Quercus alba* and *prinus*)	----------	462.2	395.4	268.9	249.6	458.5	1,834.6
Other white oaks	----------	329.1	315.4	222.0	165.0	342.5	1,374.0
Red oaks (*O. borealis, shumardii,* and *falcata* var. *pagodaefolia*)	----------	192.2	181.1	201.1	112.5	209.0	895.9
Other red oaks	----------	622.4	585.5	502.6	404.4	867.8	2,982.7
Sugar maple	----------	31.7	31.1	37.3	10.5	48.4	159.0
Beech	----------	26.0	28.5	53.0	65.6	178.0	351.1
Sweetgum	----------	126.3	118.4	98.2	94.9	124.2	562.0
Tupelo and blackgum	----------	98.6	99.6	90.8	54.5	122.2	465.7
Yellow-poplar	----------	249.3	239.3	217.1	165.8	263.5	1,135.0
Other eastern hardwoods	----------	827.2	800.7	678.4	429.2	729.7	3,465.2

TABLE 27.—*Sawtimber volume in Tennessee, by species and stand size, 1948–50*

Species	All stand sizes	Large sawtimber	Small-sawtimber	Poletimber	Seedling and sapling	Nonstocked and other areas
	Million board-feet	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Softwood:						
Southern pines	2,127.1	257.6	1,155.5	674.2	38.5	1.3
Cedar	132.4	19.7	26.4	82.6	3.7	----
White pine	244.0	116.4	65.4	60.9	1.3	----
Hemlock	261.6	134.2	74.1	34.8	16.8	1.7
Cypress	249.7	145.6	91.1	13.0	----	----
Total	3,014.8	673.5	1,412.5	865.5	60.3	3.0
Hardwood:						
Red oaks	3,878.6	1,108.6	1,378.6	1,326.7	63.1	1.6
White oaks	3,208.6	809.1	1,071.9	1,246.5	76.9	4.2
Hickories	1,629.2	304.1	553.8	734.4	36.9	----
Yellow-poplar	1,135.0	274.3	512.7	338.8	9.2	----
Sweetgum	562.0	120.4	307.1	124.9	8.0	1.6
Black and tupelo gums	465.7	116.0	182.2	158.7	8.8	----
Other hardwoods	2,346.1	667.7	862.2	751.7	59.3	5.2
Total	13,225.2	3,400.2	4,868.5	4,681.7	262.2	12.6
All species	16,240.0	4,073.7	6,281.0	5,547.2	322.5	15.6

TABLE 28.—*Sawtimber volume in Tennessee, by species and Survey region, 1948–50*

Species	State	West	West-Central	Central	Plateau	East
	Million board-feet	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Softwood:						
Shortleaf pine	1,203.9	56.3	83.4	----	386.1	678.1
Virginia pine	662.6	.7	3.7	----	147.2	511.0
Other pines	504.6	----	----	----	29.8	474.8
Cedar	132.4	21.8	8.9	61.1	17.6	23.0
Other softwoods	511.3	247.7	2.0	----	113.6	148.0
Total	3,014.8	326.5	98.0	61.1	694.3	1,834.9
Hardwood:						
Black, scarlet, and southern red oaks	2,761.1	487.2	406.4	549.2	578.1	740.2
Cherrybark, Shumard, and northern red oaks	895.9	138.2	134.2	204.8	234.0	184.7
Water oaks	221.6	134.1	14.4	25.5	37.3	10.3
White oak	1,701.2	187.2	400.1	290.8	321.5	501.6
Other white oaks	1,507.4	217.6	149.3	234.0	404.8	501.7
Hickories	1,629.2	253.2	189.5	313.6	494.1	378.8
Yellow-poplar	1,135.0	156.5	126.7	284.8	273.1	293.9
Sweetgum	562.0	384.4	79.1	63.8	14.8	19.9
Black and tupelo gums	465.7	123.8	50.7	43.0	176.1	72.1
Elms	355.6	144.6	16.0	123.4	36.4	35.2
Soft maples	181.6	56.5	13.6	21.1	42.3	48.1
Sugar maple	159.0	7.1	16.3	50.9	55.0	29.7
Ash	205.6	52.8	13.8	60.9	27.6	50.5
Beech	351.1	40.7	25.8	129.9	115.4	39.3
Walnut	184.6	12.5	10.8	74.8	20.4	66.1
Sycamore	158.8	76.3	20.9	32.7	23.4	5.5
Hackberry	72.6	42.2	2.7	21.3	1.4	5.0
Other hardwoods	677.2	329.8	14.9	98.8	120.8	112.9
Total	13,225.2	2,844.7	1,685.2	2,623.3	2,976.5	3,095.5
All species	16,240.0	3,171.2	1,783.2	2,684.4	3,670.8	4,930.4

TABLE 29.—*Average sawtimber volume per acre in Tennessee, by forest type and Survey region, 1948–50*

Forest type	State	West	West-Central	Central	Plateau	East
	Board-feet	*Board-feet*	*Board-feet*	*Board-feet*	*Board-feet*	*Board-feet*
Softwood:						
Southern yellow pine	1,337	740	932	----	1,012	1,634
Cedar	426	[1]	269	358	[1]	[1]
Other softwood	[1]	----	----	----	[1]	[1]
Total	1,150	893	625	358	1,108	1,668
Hardwood:						
Bottom-land hardwood	2,135	2,201	1,329	1,832	[1]	[1]
Upland hardwood	1,345	1,622	841	1,440	1,429	1,724
Upland hardwood-pine	1,098	731	879	847	835	1,408
Total	1,368	1,817	862	1,444	1,241	1,575
All types	1,315	1,774	846	1,145	1,201	1,613

[1] Sample too small to be reliable.

TABLE 30.—*Softwood sawtimber volume in Tennessee, by tree grade and stand quality, by species group or Survey region, 1948–50*

Species group or Survey region	All grades	Grade 1	Grade 2	Grade 3	
				In fair and better stands	In poor stands
	Million board-feet	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Species group:					
Shortleaf pine	1,203.9	192.4	316.3	134.6	560.6
Other southern pines	923.2	12.3	73.5	83.3	754.1
Cedar	132.4	132.4	----	----	----
Other softwoods	755.3	107.1	131.0	113.0	404.2
Total	3,014.8	444.2	520.8	330.9	1,718.9
Survey region:					
West	326.5	89.6	87.7	30.1	119.1
West-central	98.0	21.6	22.8	14.1	39.5
Central	61.1	[1] 61.1	----	----	----
Plateau	694.3	55.8	138.5	106.8	393.2
East	1,834.9	216.1	271.8	179.9	1,167.1
Total	3,014.8	444.2	520.8	330.9	1,718.9

[1] Cedar is the only species represented here.

TABLE 31.—*Hardwood sawtimber volume in Tennessee, by log class and stand quality, by species group or Survey region, 1948–50*

Species group or Survey region	All grades	Standard lumber logs					Tie and timber logs		
		Grade 1	Grade 2	Grade 3					
				Total	In fair and better stands	In poor stands	Total	In fair and better stands	In poor stands
	Million board-feet	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Species group:									
Red oaks	3,878.6	394.2	763.4	2,166.1	592.0	1,574.1	554.9	116.6	438.3
White oaks	3,208.6	262.0	739.1	1,975.0	432.7	1,542.3	232.5	52.4	180.1
Hickories	1,629.2	112.5	322.8	1,042.3	248.4	793.9	151.6	31.8	119.8
Yellow-poplar	1,135.0	71.0	224.7	546.3	164.4	381.9	293.0	67.5	225.5
Sweetgum	562.0	52.4	63.9	291.1	70.9	220.2	154.6	49.1	105.5
Black and tupelo gums	465.7	43.8	107.0	277.4	72.3	205.1	37.5	15.3	22.2
Other hardwoods	2,346.1	235.3	399.7	1,401.7	449.8	951.9	309.4	63.8	245.6
Total	13,225.2	1,171.2	2,620.6	7,699.9	2,030.5	5,669.4	1,733.5	396.5	1,337.0
Survey region:									
West	2,844.7	350.7	420.2	1,509.9	475.0	1,034.9	563.9	175.3	388.6
West-Central	1,685.2	42.1	239.3	1,108.7	133.2	975.5	295.1	31.0	264.1
Central	2,623.3	249.2	490.6	1,570.6	338.4	1,232.2	312.9	57.1	255.8
Plateau	2,976.5	264.6	642.5	1,810.3	468.6	1,341.7	259.1	53.3	205.8
East	3,095.5	264.6	828.0	1,700.4	615.3	1,085.1	302.5	79.8	222.7
Total	13,225.2	1,171.2	2,620.6	7,699.9	2,030.5	5,669.4	1,733.5	396.5	1,337.0

TABLE 32.—*Net volume of all timber on commercial forest land, by class of material and species group, Tennessee, 1948–50*

Class of material	Total	Softwood	Hardwood
	Million cubic feet	*Million cubic feet*	*Million cubic feet*
Growing stock:			
Sawtimber trees:			
Sawlog portion	2,610.5	519.5	2,091.0
Upper stem portion	862.5	70.2	792.3
Total	3,473.0	589.7	2,883.3
Poletimber trees	2,255.5	336.5	1,919.0
Total growing stock	5,728.5	926.2	4,802.3
Other material:			
Sound cull trees	786.6	26.5	760.1
Rotten cull trees	777.5	19.3	758.2
Hardwood limbs	621.3	----------	621.3
Salvable dead trees	63.7	5.5	58.2
Total other material	2,249.1	51.3	2,197.8
Total, all timber	7,977.6	977.5	7,000.1

TABLE 33.—*Net annual growth of growing stock and sawtimber in Tennessee, by species group and class of timber, 1949*

Class of timber	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Sawtimber trees	195.2	39.4	155.8	877.0	187.4	689.6
Poletimber trees	90.3	14.5	75.8	----------	----------	----------
Total	285.5	53.9	231.6	877.0	187.4	689.6

TABLE 34.—*Net annual growth per acre of growing stock and sawtimber in Tennessee, by forest-type and stand-size group, 1949*

Stand-size group	Growing stock			Sawtimber		
	All types	Softwood types	Hardwood types	All types	Softwood types	Hardwood types
	Cubic feet	*Cubic feet*	*Cubic feet*	*Board-feet*	*Board-feet*	*Board-feet*
Sawtimber stands	37	44	36	151	179	144
Poletimber stands	21	22	21	54	55	54
Other stands	8	5	9	12	10	12
All stands	23	23	23	71	71	71

TABLE 35.—*Annual cut of growing stock and sawtimber in Tennessee, by species group and product, 1949*

Product	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Sawlogs	121.4	43.9	77.5	588.5	232.5	356.0
Veneer logs	2.8	[1]	2.8	14.0	.2	13.8
Cooperage bolts	8.2	[1]	8.2	37.8	.2	37.6
Pulpwood	7.1	3.9	3.2	11.1	5.4	5.7
Fuelwood	85.7	10.5	75.2	283.2	49.3	233.9
Chemical wood	2.8		2.8	7.2		7.2
Piling	[1]	[1]	[1]	.3	.1	.2
Poles	.4	.4		2.1	2.1	
Posts	9.4	2.5	6.9	18.8	.3	18.5
Hewn ties	1.4		1.4	6.0		6.0
Mine timbers	1.2	.7	.5	.9	.9	
Miscellaneous logs and bolts	11.9	.9	11.0	43.2	3.7	39.5
Total	252.3	62.8	189.5	1,013.1	294.7	718.4

[1] Negligible.

TABLE 36.—*Annual cut of growing stock and sawtimber in Tennessee, by species, 1949*

Species	Growing stock	Sawtimber	Species	Growing stock	Sawtimber
	Million cubic feet	*Million board-feet*		*Million cubic feet*	*Million board-feet*
Softwood:			Hardwood—Continued		
Southern pines	49.1	234.9	Sweetgum	10.1	43.3
Other	13.7	59.8	Black and tupelo gums	2.6	11.1
			Yellow-poplar	12.4	54.9
Total	62.8	294.7	Other soft hardwoods	5.8	25.3
Hardwood:			Total	189.5	718.4
Oaks	116.7	431.7			
Hickory	15.9	56.6	All species	252.3	1,013.1
Other hard hardwoods	26.0	95.5			

TABLE 37.—*Annual cut of growing stock and sawtimber in Tennessee, by species group and class of timber, 1949*

Class of timber	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board-feet*	*Million board-feet*	*Million board-feet*
Sawtimber trees	207.9	53.8	154.1	1,013.1	294.7	718.4
Poletimber trees	44.4	9.0	35.4			
Total	252.3	62.8	189.5	1,013.1	294.7	718.4

TABLE 38.—*Net annual growth, annual mortality, and annual cut on live sawtimber and growing stock on commercial forest land, by species group, Tennessee, 1949*

Item	Sawtimber			Growing stock		
	Total	Softwood	Hardwood	Total	Softwood	Hardwood
	Million board-feet	*Million board-feet*	*Million board-feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Net annual growth	877.0	187.4	689.6	285.5	53.9	231.6
Annual mortality	97.4	18.1	79.3	41.1	6.6	34.5
Annual cut:						
Timber products	962.7	288.9	673.8	211.0	56.9	154.1
Logging residues	50.4	5.8	44.6	41.3	5.9	35.4
Total annual cut	1,013.1	294.7	718.4	252.3	62.8	189.5

TABLE 39.—*Output of timber products and annual cut of live sawtimber and growing stock, Tennessee, 1949*

Product	Output of timber products					Annual cut of sawtimber			Annual cut of growing stock		
	Volume in standard units		Roundwood volume								
	Standard units	Number	Total	Softwood	Hardwood	Total	Softwood	Hardwood	Total	Softwood	Hardwood
			Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Sawlogs	M bd.-ft.[1]	604,449	97,076	39,747	57,329	588,500	232,500	356,000	121,400	43,900	77,500
Veneer logs and bolts	M bd.-ft.[1]	12,764	1,787	30	1,757	14,000	200	13,800	2,800	[2]	2,800
Cooperage logs and bolts	M bd.-ft.[1]	28,183	4,056	26	4,030	37,800	200	37,600	8,200	[2]	8,200
Pulpwood	Std. cords [3]	[4] 158,059	12,153	4,499	7,654	11,100	5,400	5,700	7,100	3,900	3,200
Fuelwood	Std. cords [3]	[5] 1,674,000	125,610	11,310	114,300	283,200	49,300	233,900	85,700	10,500	75,200
Piling	M linear feet	41	41	17	24	300	100	200	[2]	[2]	[2]
Poles	M pieces	88	361	361		2,100	2,100		400	400	
Posts	M pieces	14,776	9,309	2,550	6,759	18,800	300	18,500	9,400	2,500	6,900
Hewn ties	M pieces	113	793		793	6,000		6,000	1,400		1,400
Mine timbers	M cu. ft.	1,089	1,089	663	426	900	900		1,200	700	500
Miscellaneous [6]	M cu. ft.	[7] 11,188	11,188	922	10,266	50,400	3,700	46,700	14,700	900	13,800
Total			263,463	60,125	203,338	1,013,100	294,700	718,400	252,300	62,800	189,500

[1] International ¼-inch rule.
[2] Negligible.
[3] Rough wood basis.
[4] No wood from mill residues used for pulp or for hard boards.
[5] Not including 28,672,000 cubic feet of wood from mill residues used for domestic and industrial fuel.
[6] Includes chemical wood, excelsior bolts, handle stock, shuttle bolts, farm timbers, etc.
[7] Not including a negligible amount of mill residues used for micellaneous products.

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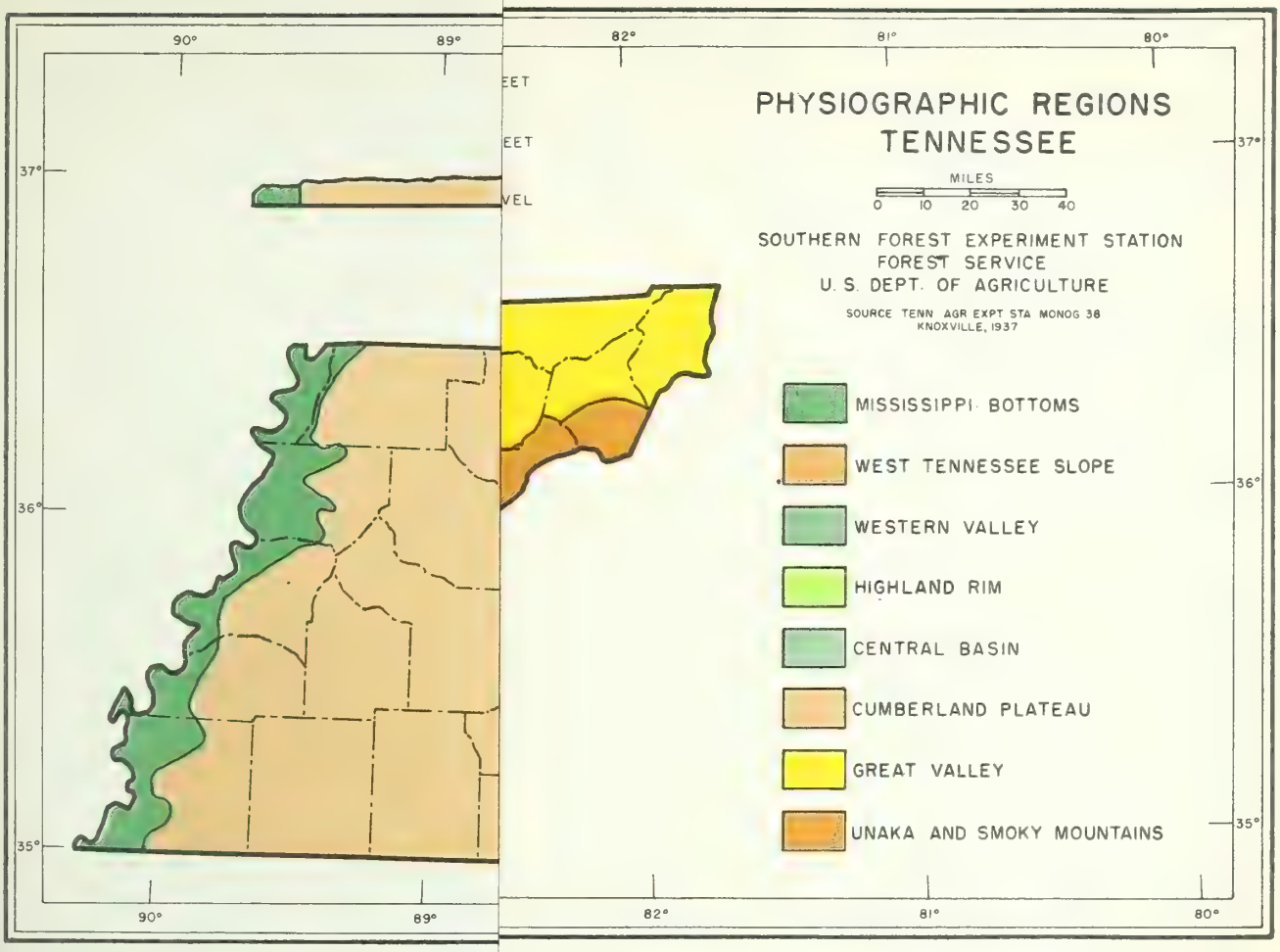

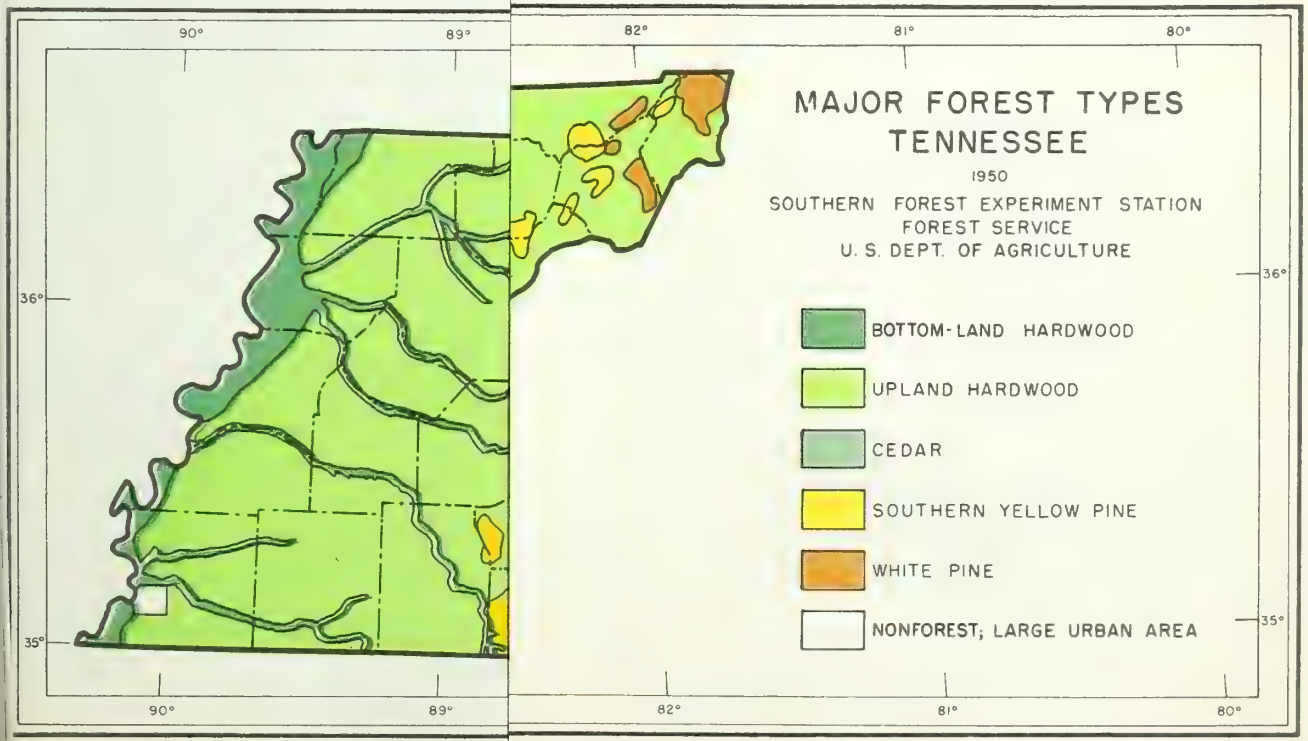

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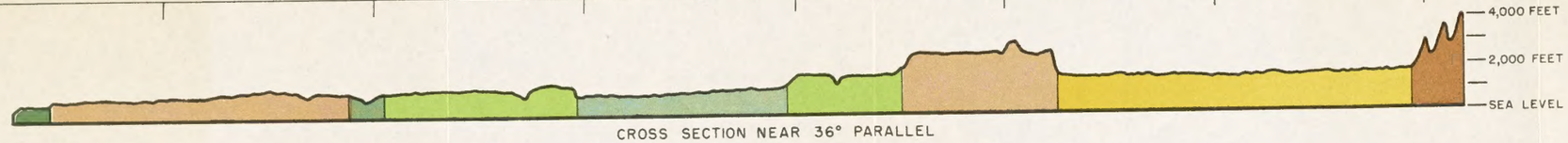

CROSS SECTION NEAR 36° PARALLEL

PHYSIOGRAPHIC REGIONS TENNESSEE

MILES
0 10 20 30 40

SOUTHERN FOREST EXPERIMENT STATION
FOREST SERVICE
U. S. DEPT. OF AGRICULTURE

SOURCE: TENN. AGR. EXPT. STA. MONOG. 38
KNOXVILLE, 1937

- MISSISSIPPI BOTTOMS
- WEST TENNESSEE SLOPE
- WESTERN VALLEY
- HIGHLAND RIM
- CENTRAL BASIN
- CUMBERLAND PLATEAU
- GREAT VALLEY
- UNAKA AND SMOKY MOUNTAINS

MAJOR FOREST TYPES TENNESSEE

1950

SOUTHERN FOREST EXPERIMENT STATION
FOREST SERVICE
U. S. DEPT. OF AGRICULTURE

- BOTTOM-LAND HARDWOOD
- UPLAND HARDWOOD
- CEDAR
- SOUTHERN YELLOW PINE
- WHITE PINE
- NONFOREST; LARGE URBAN AREA

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